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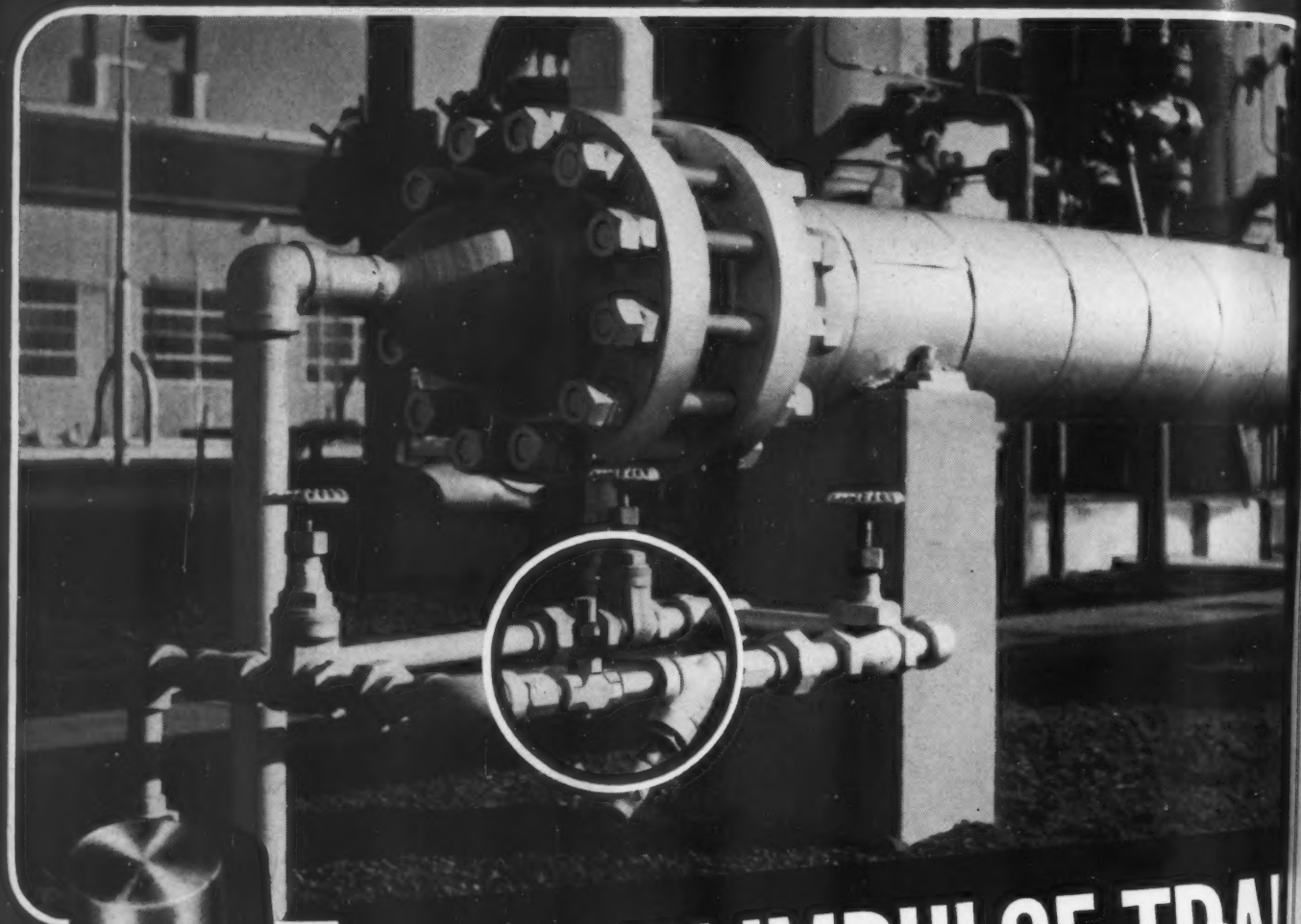

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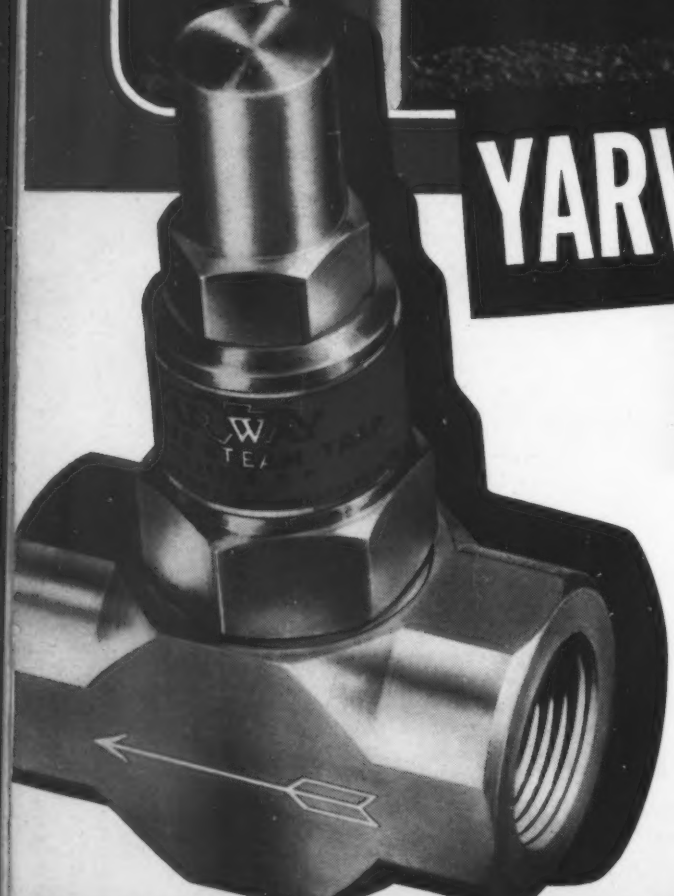

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PETROLEUM REFINER

SPECIALIZED FOR THE OIL REFINING INDUSTRY, INCLUDING PETRO-CHEMICAL ENGINEERING, PETROLEUM SYNTHETICS AND NATURAL GASOLINE

DECEMBER, 1943
Vol. 22, No. 12

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GRADY TRIPLETT
Editor

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PETROLEUM
REFINER

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THE LOOK BOX

HOWEVER improbable, it is possible that this nation has come to the point of producing less crude oil than its gasoline requirements demand. Such is the fear of Harold L. Ickes, who raises the flag of warning and offers a solution in the December 4 issue of *Collier's Weekly*.

More and at Lower Cost

The prospect of being a have-not nation in oil is not pleasant. But it is the solution of the Petroleum Administrator that is threatening. He reiterates his allegiance to private enterprise but he stresses government as the agency for solving the gasoline shortage. He proposes to turn to coal as a source of gasoline, with the government doing the experimental work thereby marking a path over which private capital later can follow.

Here is the basis for his attitude:

"It is unlikely that private capital will venture on any large scale into a new and untried industry, no matter how bright the prospects may be."

Evidently the dour Secretary has not read his industrial and commercial history. Over the ages private capital has been venturing into untried ventures regardless of the brightness of prospects. Oil can point to many instances of men who continued to experiment even beyond the point of spending what they had saved and could borrow. They ventured when prospects were dark.

The record of private industry is simply the reverse of the Ickes' premise. The individual, which is another name for private capital or individual enterprise, is not lacking in boldness. He will risk his savings, his credit and his time in order to perfect a process or adapt a process to different raw material.

The day may be near when coal will become the source of motor fuel. What official Washington should recognize is that the leadership of government is not needed to assure the processing of coal. Private industry already has the processes. It understands the cost and is determined to explore other sources first.

Before reading crude oil out of the picture, it should be noted that many do not accept as permanent the low state of reserves.

Regardless of the amount of crude oil, technologists in petroleum refining will turn first attention to natural gas as a motor fuel source. Processes are known, although little used, for this conversion. They are more expensive than processing crude oil. The point is that they are feasible, that they were developed by private enterprise and are being advanced by private enterprise.

Likewise with coal. The processes are known and feasible. When it is no longer possible to get sufficient motor fuel from oil, natural gas or shale, private enterprise will shift to coal and provide sufficient motor fuel.

The condition which might deter private capital in such a development would be government. If government stands in the way of what individuals strive to accomplish, progress will be scant.

If the world ever has benefited from a scientific development that came from a government project, it does not now come to mind. The great inventions have sprung from the profit urge rather than

altruism. This record may not fit what seems desirable, still it is the record, and all men in government should reflect on it before recommending or voting for the spending of public money for building experimental plants.

Private capital will accomplish more and at a lower cost.

Shown by Contrast

FEW recall that World War I had its aviation gasoline problem as revealed in this paragraph from an interesting book published recently by Refinery Supply Company:

"Aviation gasoline specifications first showed up on a goverment request for bids—a total call being made for less than 60,000 barrels, with specifications lower than those of today's ordinary motor fuel." The reference is to 1918, the year W. A. Schlueter founded the company at Tulsa.

A recent bulletin from the Office of War Information had this summary:

"Gasoline needs in this war are eighty times greater than in the last war. A mechanized division whose gasoline supply fails is so much scrap iron. On the move a motorized infantry division consumes 12,500 gallons per 100 miles. Not only do tanks, half-tracks and mobile repair shops continually drink vast quantities of gasoline but additional thousands of barrels daily are burned by tank trucks which bring fuel up to the fighting line. As a battle extends, gasoline must be made available at more and more points in as great quantities as possible to avoid the risk of defeat for lack of refueling."

Cost No Object

WHEN governments are making expenditures in billions, it seems trivial to ponder over the spending of a few millions. Still the fantastic figures that surround the Canol project by which oil from the Arctic circle is to be made available to the Alaskan defenses cannot be lightly dismissed. It is a revelation in what comes about when men who are not familiar with an industry enter boldly into its activities.

Canol is an Army project. The hearing before the Truman committee revealed that the Army is proud of its project. Harold Ickes, whose PAW was not consulted, condemned it vigorously and recommended that it be abandoned, since $138,000,000 of expenditure still has not completed the pipe line and refining plant at Whitehorse on the Alaskan highway. Meanwhile tanker, barge and a pipe line from Skagway are delivering gasoline to Whitehorse.

The 3000-barrel refinery at Whitehorse will cost $24,000,000, a sum sufficient for building a plant six times that capacity in the United States. The pipe line from Fort Norman to the refinery will transport but 3000 barrels of oil daily, while production is rated at 20,000 barrels.

The contractor for the pipe line shipped California redwood to Edmonton, where an office building was built for $400,000, although it is a thousand miles from the pipe line. Plans were to give the building to the city, which now insists that the California timber be covered with stucco at a cost of $4000, otherwise the contractor must tear down the structure and ship it out of Canada.

Cost of 100-octane gasoline from the Whitehorse refining plant has been estimated at $2.76 a gallon.

Canol represents development which would have been undertaken as a last extremity had the petroleum industry faced the necessity of providing fuel in the Alaskan area. Had the petroleum industry been forced to the extremity, the cost would have been far less.

The Army has made as poor showing at oil development as the petroleum industry would at winning a battle.

Refreshing Viewpoint

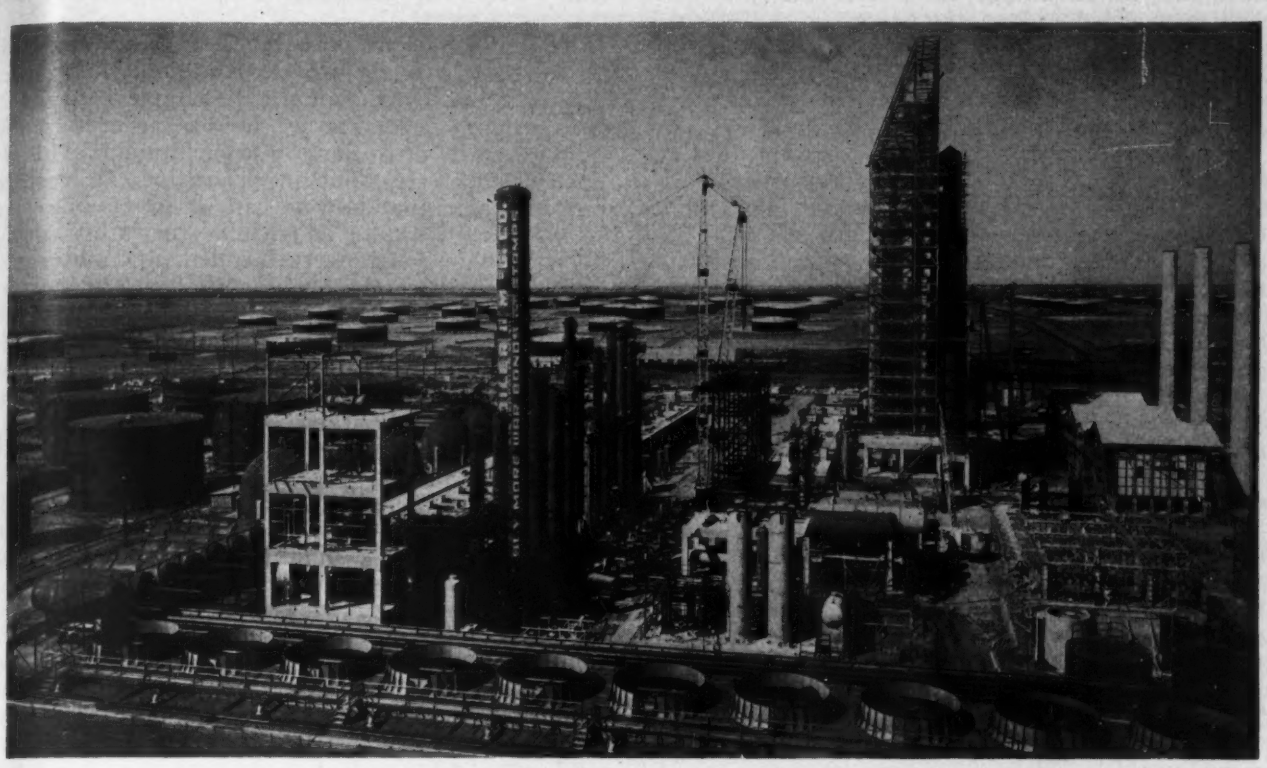
BEFORE the Maryland Academy of Sciences December 1 as a part of the program of dedicating the new Baltimore plant R. W. Gallagher, president of Standard Oil Company (N. J.), gave this estimate of the attitude of industry toward the welfare of human beings:

"As Americans we propose to help win the peace after the war is won. But political peace depends upon the economic welfare of other nations as well as our own and the road to economic welfare lies through increasing standards of living.

"America has shown that standards of living are increased by paying higher wages, at the same time and in spite of that, making better goods at lower cost. The only way this can be done is by increasing employment of mechanical energy to replace human energy. That means that the world must have better and better machines and more and more efficient power to run the machines.

"Oil is power. We must find more oil and better ways of using it. We must help our neighbors in other lands to find more petroleum and help them to use it better.

"If we in this country are to work toward the establishment of an economic foundation on which we can build a political peace, all of us must know what the job really means. Once we understand it, the job is half done because the war has proved that to Americans the word 'impossible' is still pronounced 'opportunity.' And in meeting the opportunity we will need all of the help that science can give us. We need more knowledge, more correct thinking."



Among the aviation gasoline plants scheduled for January 1 completion is that of Continental Oil Company. This picture of the skyline at Ponca City shows the alkylation, Thermofor, furnaces and other units as they were in October.

How Will the 100-Octane Aviation Gasoline Program Affect Post-War Motor Gasoline?

BRUCE K. BROWN, Assistant Deputy Administrator, and D. P. BARNARD, Consultant,
Petroleum Administration for War

THERE is a school of thought which has held that, as the demand for aviation gasoline is reduced with the cessation of hostilities, the unwanted part of the 100-octane gasoline to be used as such will be blended more or less directly into motor gasoline. Persons who look on the matter this way feel that, in the post-war period, refineries will simply, in effect, sell as much 100-octane gasoline as they can and pour the rest of it back into motor fuel.

There is another school of thought which believes that American ingenuity and technological advances made during the war will be translated very rapidly after the war into power plants for civilian automobiles which will incorporate the features of airplane engines and which will demand 100-octane fuel.

We hold it most probable that in the immediate post-war period neither of those things will happen and that the actual result will be a compromise. It appears that since no new automobiles are being manufactured and since millions of cars will be available after the war which cannot use 100-octane

WITH the return of competition in cost, processes and raw materials, the authors of this paper are of the opinion that:

"As much as 100,000 barrels of the 100-octane capacity will be shut down or diverted to other uses because of excessive operating costs and crude utilizations."

They could make public no detailed estimates as to requirements of aviation motor fuel but did note:

"It is improbable that there will be further significant increases in the requirement figures."

When the construction program for 100-octane aviation motor fuel is complete there will be 60 plants with catalytic cracking units, which will have input of 760,000 barrels per day. For post-war operation input of these units could be raised to 1,000,000 barrels per day.

The authors discussed methods for making aviation gasoline base stock as well as alkylate, hydrocimer, isopentane, neohexane and cumune in the first part of their paper before the Metropolitan Section of the Society of Automotive Engineers, December 2. Since the petroleum industry is familiar with these processes, only part of their paper is reproduced herewith.

fuel to any real advantage, the public simply will not be able to afford to pay the price for a superfuel. Further, it appears very certain that when passenger-car production is first resumed, it will be upon the basis of continuing the 1942 models, at least as far as mechanical features are concerned. In addition, in the event that substantial increases in economy are desired by the purchasing public, several other design avenues offer more promise than does the simple increasing of compression ratio with its attendant high-octane fuel requirements. It therefore seems quite improbable that there will be any substantial early demand on the part of motorists for 100-octane gasoline. It may be that, some time long after the war, engineers will produce power plants which will operate effectively on 100-octane gasoline; but even so, for an appreciable number of years to come, the automobile's diet will be determined by the digestion of the older model cars and the pocketbooks of their owners.

It appears quite definite that the production of 100-octane gasoline must take a sharp and early drop as soon as the peak military demand is passed. The emergency of war has necessitated the forcing of every possible available unit to its utmost capacity and the taking of stringent measures which in many instances are quite uneconomical. As soon as the government ceases to be a willing buyer for 100-octane gasoline, regardless of cost, and as soon as diminishing demand brings again into play the old law of supply and demand and brings about a return of a buyers' market, the reduced market for high-octane gasoline will be supplied from low-cost-production units.

It has been pointed out that manufacturers of codimer have been forced to produce ingredients for high-octane gasoline without regard either to cost of the codimer or its effect upon the other refining operations and also that the operators of catalytic cracking units were forced to convert them to the manufacture of base stocks at cost and yields from crude which in all probability could not survive after the war. These are illustrations of the manner in which 100-octane production was achieved under the duress of war emergency.

As another illustration of the ephemeral character of much of our 100-octane gasoline produced during the early stage of the war, it should be appreciated that the petroleum industry in "lifting itself by its boot-straps" to produce greatly increased quantities of high-octane aviation gasoline without having completed its new manufacturing facilities, of necessity, had to operate almost all of its refineries as if they belonged to one organization. This was done under the guidance and authority of the Petroleum Administration. In this operation, components from East Chicago, for example, were sent by tank car to Philadelphia to be blended in 100-octane gasoline; components from Whiting, Indiana, were sent to Texas, and isobutane available on the East Coast was shipped by pressure tank car to the West Coast. These operations, however, extravagant both in operating and transportation cost, practically saved the day for our Air Forces. Obviously, they could not be continued in peacetime if for no other reason than that the anti-trust laws would prevent it. In order to be entirely clear on this point, it should be definitely stated that we think that a great deal of 100-octane production which this country was making available by the middle of 1943 was wartime emergency production which will continue only as long as the war and which will certainly stop immediately after the war.

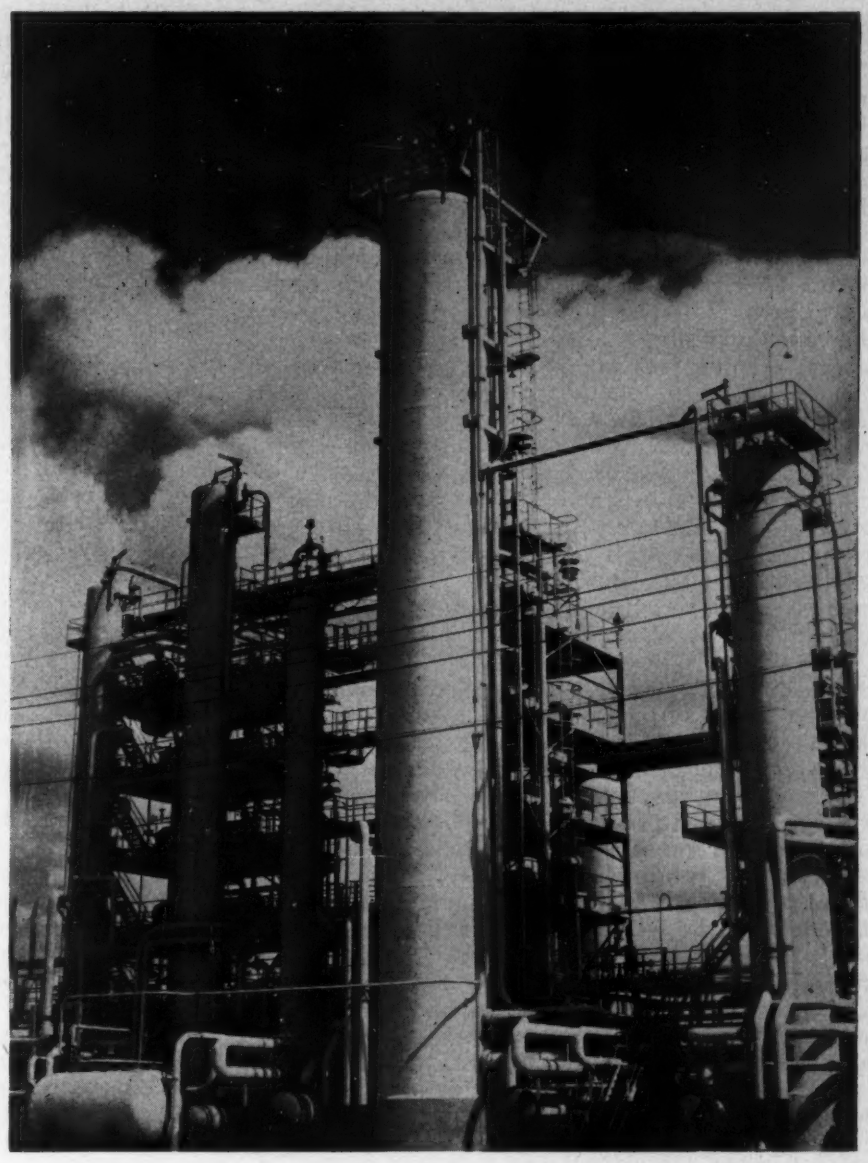
Similar situations probably exist for many of the processes now being used to make aviation gasoline and its components. Perhaps the simplest illustration is the isomerization process now being used to make isobutane out of ordinary normal butane. This is a wartime necessity, but in peacetime, at least, the highest value that butane can be given in refining economics is its value as gasoline (or rather what its value would be if it were blended into motor gasoline). It is perfectly obvious that in the post-war world, isobutane made by a chemical process from normal butane will have to compete in price with such isobutane as is available from natural gasoline and from any and every other process. This does not mean that when the war is over we will entirely cease to isomerize butane. It does mean, however, that the less economical units will probably stop operating.

This same thing is true, in principle, of other processes. It may even be true of certain cracking processes which use high-quality naphtha as a raw material. These processes will, in effect, "make gasoline out of gasoline," or, at best, out of high quality virgin stocks almost as valuable as gasoline. Such operations will be required to compete with other processes which actually create gasoline out of much lower grade petroleum fractions. As has already been pointed out, many of the operations currently producing 100-octane gasoline are extravagant in a number of ways, including their requirements for crude oil. The United States is not going to run out of crude oil for many years yet to come, but it is fairly evident to all concerned that our national crude oil position is rapidly changing from one in which we are producers of excess crude to one in which we will be required to import our marginal crude requirements. This change in position is apt to alter the fundamentals of our refining economics and will severely penalize those operations which do not use crude oil to maximum efficiency. The crude situation, therefore, will place much emphasis upon the desirability for shutting down as soon as possible after "V Day" those aviation gasoline manufacturing operations which are wasteful of crude. This, incidentally, may affect a very large percentage of the wartime units.

How much 100-octane gasoline will be required for aviation use after the war?

The real answer to the foregoing question, of course, involves an accurate estimate of the economic and political conditions after the war. Certainly the authors do not possess the clairvoyance necessary to forecast this picture with any appreciable degree of accuracy. However, certain estimates must be made if we are to arrive at any kind of a picture of the post-war motor gasoline situation.

Prior to the development of the present national emergency, all civilian aviation gasoline uses totaled less than 9000 barrels per day, with scheduled airline consumption accounting for just about half. If we assume that a five-fold increase in domestic airline fuel consumption will develop during the first five post-war years and that the use of aviation gasoline by other civilian agencies (including engine builders) will increase in like amount, we conclude that the total post-war civilian aviation gasoline requirement may be in the neighborhood of 50,000 barrels daily. Of this, of course, the lion's share must be selected on the basis of economic considerations and, therefore, can embody only those components which can be



Foremost blending material is alkylate for bringing base stock near the 100-octane rating. This unit is part of facilities recently completed by Magnolia Petroleum Company at Beaumont.

produced at the lowest cost. It may be that the bulk of this business will continue to use the familiar more economical 91-octane grade currently used by the airlines. Post-war military demands are, of course, almost impossible to predict. Prior to the emergency, they accounted for scarcely 5000 barrels daily and just before Pearl Harbor had risen to something less than 30,000 barrels daily. If we assume that such demands will rapidly drop at the conclusion of the war to about 50,000 barrels daily, we would still be operating at about ten times the pre-emergency level. This fuel will, of course, fall in the highest octane number category and in all probability will be better than the present 100-octane grade.

In general, such estimates as can be made at this time indicate a maximum probable early post-war demand for all aviation fuels of about 100,000 barrels daily, of which somewhat more than half will be of the high-octane type, while the balance will be selected mainly on a cost basis. Our estimates may or may not be accurate within 50 percent, but in any event, it appears that any probable variation in the amount of aviation gasoline required in the early post-war period will have comparatively little effect upon the quality of post-war motor gasoline. Therefore, it is believed that the foregoing estimates should suffice for the purpose at hand.

To what extent will other requirements compete for high-octane gasoline components and for manufacturing facilities?

Discussion up to now has dealt primarily with refining economics and its effect in determining how much of the high-octane aviation gasoline facilities may be operated under peacetime conditions. However, there is another factor which must be appraised in determining the amount of high-octane gasoline components to be available for use in motor gasoline after the war. This is the possibility of a greatly enlarged opportunity to produce chemicals from petroleum. The war has already brought into being one important new industry which depends upon petroleum; namely, the synthetic rubber industry. The same butylene which can be and is used as an important raw material in the production of high-octane blending agents can and is being used for making butadiene for Buna rubber; and the same isobutylene which is also a valued ingredient for isooctane blending agents is the raw material from

which Butyl rubber is made. Should there be any post-war expansion in the synthetic rubber business, either as the result of increased demand for rubber as such, or because technological improvements will permit synthetic rubber to be used to a greater extent and in wider fields than natural rubber was used, the logical source of the raw material for such an expansion would be the refining equipment now being used to produce 100-octane gasoline. The tremendous war-time output of butylenes for 100-octane gasoline and for rubber suggests that as military demand for aviation fuel drops off from the peak butylenes may drop in price. The last increment of butylene forced from an "unwilling unit" usually occasions the greatest refining loss and the greatest maintenance expense.

Butylene, isobutylene and isobutane are active materials from the chemical standpoint and it is very likely that there will be a demand for them by industries other than synthetic rubber. Turning now to the base stock, i.e., the high-octane naphtha which forms the preponderant part of 100-octane gasoline, the present trend is such that these base stocks are being produced to contain maximum proportions of aromatic hydrocarbons. Should the chemcial industry develop a sizable demand for benzine, toluene, and xylene, it would be most logical to obtain these materials from the naphtha that would otherwise be available for 100-octane gasoline.

How much will be left for use in motor fuel?

The foregoing discussions present two reasons for assuming lessened production: one based on refining economics, and the other based on possible advances in technology. While there can be no such thing as definite quantity of 100-octane aviation gasoline available after the war, certainly (if the demand continues) there is no reason to assume that we cannot continue to produce the amount necessary to satisfy that demand. However, as the demand is reduced (and certainly there wil be a substantial reduction), the result definitely is not going to be that there will be a considerable excess of 100-octane gasoline available on a distress market. On the contrary, *that part of the 100-octane gasoline which is not required simply will not be produced.*

If we combine this conclusion with the obvious fact that there will be some requirement for high-octane post-war aviation gasoline, it becomes fairly evident that with some possible minor exceptions the real effect of the aviation gasoline war program on post-war motor gasoline quality will be to make available, after the war, certain facilities—notably for catalytic cracking—which instead of manufacturing aviation gasoline base stock will be operated under more economical conditions to make motor gasoline.

How will the extent of its use in motor fuel be determined?

In line with the foregoing, it appears that the extent to which high-octane aviation gasoline manufacturing facilities will contribute to post-war motor gasoline quality can be briefly summarized about as follows:

(1) Most catalytic cracking capacity will be converted to the manufacture of high-octane motor gasoline as rapidly as possible after the conclusion of the war.

(2) Alkylates and other high-octane blending agents will find their way into motor gasoline only to a comparatively slight extent and then only as their use can be justified as means for vapor pressure control, i.e., as means for incorporating in motor gasoline the high-octane but very volatile butanes and the like which might otherwise be lost.

(3) Polymerization units will no longer produce the expensive codimer required for aviation-gasoline use, but rather will revert to their pre-war procedures of non-selective polymerization in which they occupy a position similar to that predicted above for alkylation; namely, to increase octane number and in the same sense as means for vapor-pressure control.

(4) The various isomerization processes, and also hydroforming, must occupy a marginal position if they are to figure in post-war motor-gasoline manufacture at all. Essentially these processes "make gasoline out of gasoline" which, in turn, means that they can be justified only as long as the cost of the operation as a quality improving procedure can be passed on to the ultimate purchaser. It may well be that some of these processes will find a few important applications in the post-war picture, but it is fairly certain that they will not account for any substantial percentage of ultimate motor-gasoline production. By and large, therefore, it appears that the effect of the aviation-gasoline program on post-war motor-gasoline quality can be judged on the basis of the effect of catalytic cracking facilities.

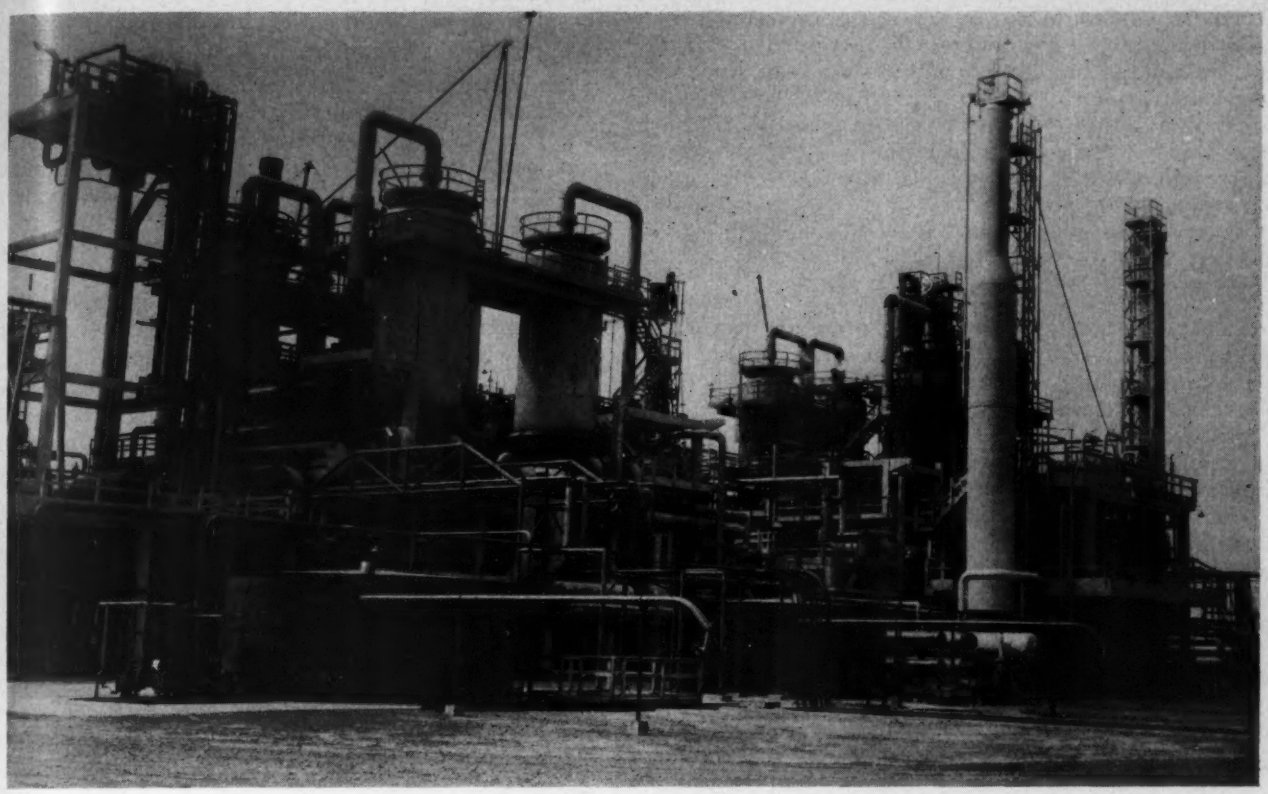
Within the limits of accuracy of the estimates which can be made, it would appear that catalytic-cracked motor gasoline will be produced to the limit of capacity of the available equipment, even though this may involve the shutting down of a substantial portion of the older thermal-cracking units. If this is done, possibly 25 to 30 percent of the post-war motor gasoline production in this country may consist of catalytic-cracked naphthas as the principal contribution of the war-time aviation-gasoline program to post-war motor-gasoline quality.

What increase in the octane number of motor fuel will result?

Catalytic-cracked naphthas as produced for motor-gasoline manufacture will, in general, tend to run 10 to 12 octane numbers higher than the materials which they will replace. This, therefore, indicates that the net effect of the aviation-gasoline program will be to permit an increase of from 2 to 3 octane numbers on the average over immediate pre-war levels. This estimate, of course, assumes that lead usage will not vary appreciably over that prevailing before the war. We do not mean to imply that immediately after the war the octane numbers of all gasolines marketed throughout the country will uniformly increase by 2 to 3 octane numbers. On the contrary, much of the catalytic-cracking capacity to which reference is made is localized in a few areas of the country. It may well be, therefore, that certain manufacturers will offer products representing substantially greater improvements than the average indicated.

There is considerable opinion to the effect that the advantages of high-octane catalytic-cracked gasoline may appear, in considerable part, as markedly improved premium-type gasoline. Obviously, so long as premium gasoline accounts for a comparatively small percentage of the total, many manufacturers might find themselves able to market premium gasolines of very high knock rating, indeed. The best guess as to the extent to which the octane levels of such products may be increased probably can be based upon a consideration of automobile requirements.

There are many reasons why we may anticipate a civilian demand for gasoline of improved octane numbers. One of these, of course, is that the automo-



In the first two years of American participation in the war the Houdry Process carried the brunt of keeping airplanes of the United Nations in supremacy.

bile companies will wish to start with a new slate in order to produce the best type of automobile to be used by our people. It appears to us that in the post-war period, taxes will inevitably be very high and motor fuel will have to carry a large share of this tax. Also, unless there is a marked change in the outlook for crude oil in this country, it appears that in the post-war period we will have every reason to economize as much as possible on the quantity of crude petroleum used for transportation. The automobile and petroleum industries have never been able to stray very far from the fundamental basis of the maximum number of car miles obtainable from a barrel of crude, at the same time complying with acceptable standards of performance. These factors indicate a real demand for an economy automobile as soon as possible after the war. Such an automobile might, of course, take the form of a small light car having a somewhat lighter and more powerful motor of the high compression type and requiring a very high-octane fuel. It appears, however, that certain other avenues for improving economy appear more immediately attractive than that of mere compression-ratio increase. We refer, of course, to the now well-recognized method of reducing engine speed and amount of mixture breathed per car mile, and the significant position of the automatic transmission in effecting such improvements. By such means, quite large economies can be effected without recourse to high compression ratios with their attendant high engine and fuel manufacturing costs.

It is our belief that perhaps too much significance has been attached to the expression "100-octane aviation gasoline." Actually, as is well-known, the octane number of aviation gasoline while highly important is only one of several equally important qualities. In particular, aviation gasolines must be made to much narrower boiling ranges than are required for automobile use which, in turn, profoundly influences yields obtainable from a given quantity of crude. However, the fact should not be overlooked that 80-octane gasoline is still very good gasoline.

By and large, it appears that about 85-octane, as expressed by the ASTM procedure, represents the highest knock rating which can be used effectively by automobiles to be available in the immediate post-war period. By the expression "used effectively," we mean automobiles which, by virtue of design, construction, and maintenance, are able to deliver the performance and fuel economy necessary to justify the costs associated with producing fuel of that quality. It has been emphasized by the foremost authorities in the automobile industry that far-reaching fundamental engine-design changes will be required to make possible the effective utilization of gasolines much over 85-octane number. The writers, therefore, hazard the guess that in the first post-war year or so motor gasoline will rapidly approach octane levels of about 85 for premium and around 80 for the regular grade. If there are still "octanes to spare," they probably will be used in the deluxe (premium) grade of fuel. It appears, further, that a third grade of lower octane number will still be available at a lower price. These fuels will adequately take care of the highest requirements of the cars producible in the immediate post-war period, as well as the great bulk of pre-war designs which, of course, will constitute the preponderant share of cars in use at that time.

If these values seem discouragingly below the glowing predictions which have occasionally appeared in the press and which have been bandied about so blithely, we should not overlook the fact that 85- or

even 80-octane gasoline is still very good gasoline. Further, we should not overlook the fact that practically none of the cars currently on the road can take full advantage of motor gasolines as they were supplied just prior to the war. It, therefore, appears that the war aviation-gasoline program will contribute to post-war gasoline a quality increase which at first sight will seem rather modest but which, on closer scrutiny, will be adequate to support the development of cars of the improved economy characteristics certain to be in greatest demand.

Conclusion

First, 100-octane aviation gasoline is now being made to the maximum capacity of the industry without regard to the economics of operating cost, transportation, or crude utilization.

Second, under peace-time conditions, the amount of such gasoline to be required must, of course, be but a fraction of the wartime requirements.

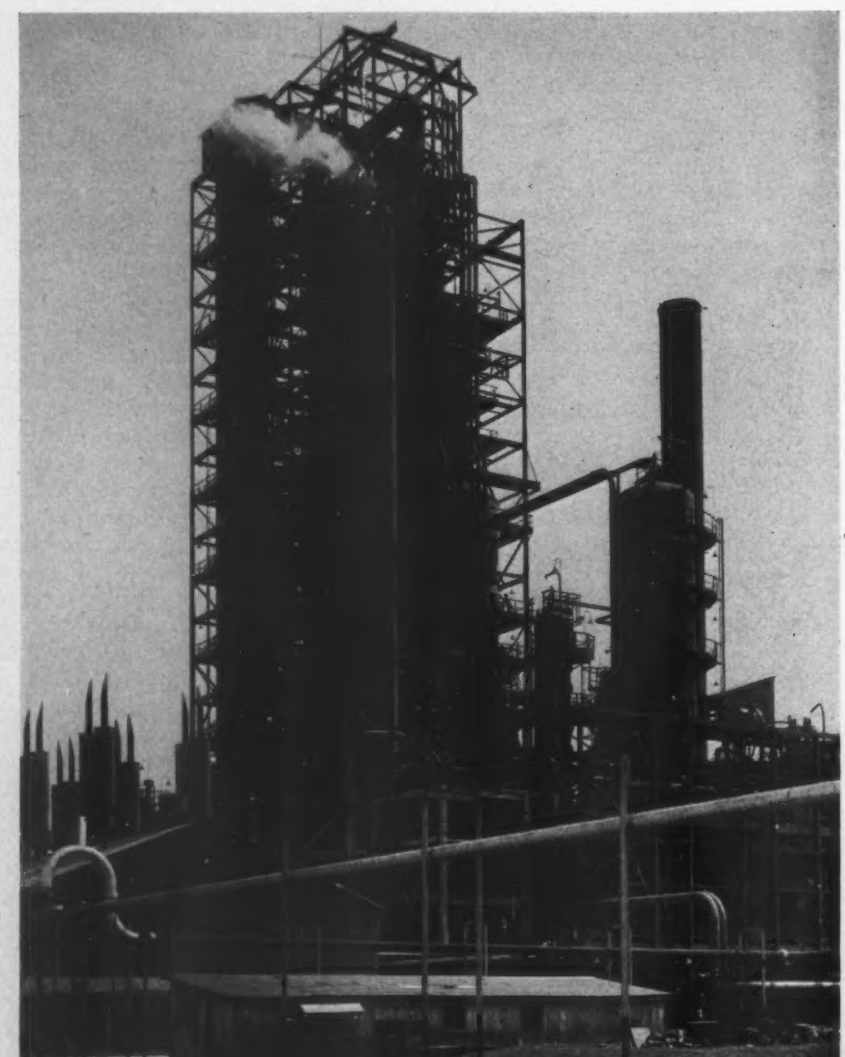
Third, under such conditions, the amounts which can be made within the acceptable limits of economics of crude utilization and using the equipment of the war-emergency program are probably not over half of the present schedule.

Fourth, the net result is that immediately after the war a substantial portion of our emergency aviation-gasoline-manufacturing facilities will be discharged from war duty, and those which can be economically operated will be turned to the manufacture of motor gasoline for which they will run under conditions chosen for economy rather than miximum octane number.

Fifth, these and the other factors concerned in this discussion seem to indicate that immediately after the war we can expect that the average octane number level of motor gasoline may increase as much as three units over immediate pre-war values and that the majority of the marketers will be able to offer house-brand products around 80-octane and premium products of, say, 85-octane.

Sixth, it seems fairly probable that values higher than these would result in extravagances in crude usage which will not be tolerable after the war.

In conclusion, it is not intended that the foregoing be interpreted as indicating that 100-octane motor gasoline will never be feasible as an automobile fuel. Rather, the picture appears to be that immediately after the war the foregoing improvements are definitely practical with succeeding improvements possible but requiring equipment design, development, and construction. In other words, improvements much above the indicated levels will be "evolutionary rather than revolutionary," and the evolution must be predicted with due regard to the fact that at these high-octane levels already prevailing each succeeding octane number improvement becomes increasingly difficult to achieve.



Although only a few months old this fluid catalyst unit is a veteran. It was the second plant of that process to go on stream. It is at the Baytown plant of Humble Oil & Refining Company.

Test Pressure and Safe Dimensions Of Welded Pressure Vessels

H. F. LASSNER

As CAREFULLY as both the ASME and the API-ASME codes for welded pressure vessels have been prepared, it has, naturally, not been possible to cover each and every detail of design and fabrication coming up in practice. One or the other passage in the code seems to allow for different interpretations and it is up to the good judgment of either the designer or the inspector of a vessel whether he considers certain details and dimensional data admissible or compatible with the code or not. Like any other laws, the code rulings are an excellent means for the establishment of order and public safety in their particular line. Like any law, however, they should not be applied in an automatical, stereotyped way, but they should be interpreted with a thoughtful understanding of the basic ideas upon which they had been established. A well meant, but all to verbal interpretation of the codes leads many designers to overdimensioning of some vessel parts that had not been intended by the "legislators" who prepared the codes. It is necessary to grasp the fundamental thoughts that led to the conception of design standards of this kind in order to arrive at a sensible understanding of certain paragraphs. Sensible, because it takes care of the safety angle as well as of the economy in design which lies not only in the purchasers interest but also in a public interest in our time.

A typical item of the mentioned sort, where considerable confusion exists, is the determination of the pressure for the hydrostatic test. Both codes define the tests pressure as not less than 1.5 times the allowable working pressure. In paragraph U-64 of the ASME Code the relative rules say that the maximum allowable working pressure "used in determination of the test pressure shall be that at normal atmospheric temperature and based on the actual dimensions and plate thicknesses required for the pressure and temperature that are to be stamped on the vessel." The expression "actual thickness" usually is interpreted as the thickness of shell or heads as manufactured, thus including an eventual excess thickness used because the calculated value gets in between two standard plate thicknesses of which the greater is to be chosen. However, if the rest of the mentioned sentence is considered: ". . . required for the pressure and temperature that are to be stamped . . ."—it is rather doubtful if the above understanding applies. There is no reason against a conception that the dimensions and plate thicknesses required for the service condictions are just the ones resulting from the design calculations stipulated in the code, excluding any excess wall beyond that thickness. In that case the test pressure is only 1.5 times the design pressure.

The corresponding paragraph W-525 of the API-ASME Code is quite differently worded. "The test pressure shall be determined by the allowable working pressure of the weakest part of the vessel as computed from the formulas and methods of design required by this Code (assuming corrosion allowance "c" to be zero, and the maximum allowable working stress "s" to be that permitted at test temperature) and also from other loadings which may exist during the test." That indicates that the a.w.p. is to be figured back from the sum of the thickness required for the design pressure plus eventual other loads plus the thickness added for corrosion.

Although the expression "actual thickness" is not used here as in the ASME Code, it has become standard practice to base the a.w.p. on the full thickness "when new", including corrosion allowance and an eventual excess wall that often occurs due to the mentioned or other conditions. The idea is to stress the material in a linear proportion higher as it is thicker, so that after corrosive thinning the wall will still safely stand the design pressure.

Flat Cover Design

It is evident that any excess wall makes the vessel, after corrosion has acted, stronger than it is required by the strength computation, thereby making for a higher factor of safety. Somewhat different is a condition, when f.i. a large horizontal storage tank has to stand localized stresses at the locations of its supports. Then, by structural reasons, the vessel wall must be chosen much heavier than the relatively low internal pressure would require and the a.w.p. "when new" is by far higher than the internal design pressure.

A flat manhole cover is to be figured as outlined in paragraph W-316 of the API-ASME Code. This paragraph is not entirely outspoken as to what value should be used as a.w.p. for the determination of the cover thickness. A rather important footnote to paragraph W-525 indicates that during the first hydrostatic test the longitudinal joint of a vessel should be given a minimum stress equal 1½ times the a.w.p. related to its thickness. This procedure is not mandatory, but whenever the longitudinal weld is not stressed that high at the test after completed fabrication, the code prescribes periodic pressure tests to be conducted after the vessel has been taken into service—a rather undesirable proposition for the user of a vessel. In other words, if any part of a tank other than the longitudinal seam becomes its weakest part, thus determining the admissible test pressure, periodical pressure tests have to be given during its service.

Quite often a manhole cover thick enough to stand the internal design pressure may become the weakest part if a vessel's wall, for reasons of rigidity, contains the mentioned excess thickness. In such a case most designers will increase the manhole-cover thickness to a value based on the a.w.p. related to the heavy vessel wall, thus rendering to its longitudinal seam its function as "limiting part" for the pressure during the test. As laudable as such strict adherence to the code rules may be, it appears not entirely justified from a practical angle.

To illustrate these conditions, a typical example will be given. A horizontal storage tank has 10 feet mean diameter, 40 feet length, design pressure (internal) of 30 psi., no corrosion allowance required. The tank has a 16-inch series 15 standard manhole. Material to be ASTM spec. A70 flange quality steel, no radiographing, no stress relieving (joint efficiency $E=_0$, 78).

According to $T=\frac{pDm}{2sE}$ vessel wall thicknesses are shown proportional to maximum a.w.p. in Figure 1, line "a."

According par. W-316 manhole covers are figured as follows: $H=\frac{d^2\pi}{4}\times p$; $C=0.3+\frac{1.4\,Wh_G}{Hd}$; $t=d\sqrt{\frac{Cp}{s}}$

$W=16\times 0.694\times 1100=122{,}000$ lbs.

Standard dimensions for a 16-inch Series 15 cover are shown in Figure 2. Cover thicknesses are plotted against a.w.p. in Figure 1, line b. From the smaller slope of this line it may be seen that the cover thickness grows much slower with increasing pressure than the vessel wall does.

For an internal pressure of 30 psi the cover thickness is figured to 1.335 and this dimension is rounded up to 1⅜-inch thick plate. The figured value for the vessel wall, when 30 psi internal pressure is applied $T=0.17$ inch. To meet concentrated stresses at the supports a shell thickness $T=¾$ inch is chosen instead of the theoretical value of 0.17 (the procedure in determining the reinforcement required at the supports goes beyond the scope of this paper). Figuring back from $T=¾$-inch, an a.w.p. of 134 psi is found, resulting in a test pressure of

$$p_{test}=1.5\times 134=201 \text{ psi.}$$

Checking a 1375 in. cover against this test pressure

$$H=\frac{18.5^2\pi}{4}\times 201=54{,}000 \text{ psi; } C=0.3+$$

$$\frac{1.4\times 122{,}000\times 2}{54{,}000\times 17.25}=0.3+0.366=0.666$$

$$S=\frac{d^2}{t^2}C\times p=\left(\frac{17.25}{1.375}\right)^2\times 0.666\times 201=21{,}000 \text{ psi.}$$

it is found that the resulting stress in the cover during the hydrostatic test (21,000 psi.) is by far lower than the yield point of the material and its temporary application while testing appears absolutely safe, although the test pressure amounts to almost 7 times the value for which the cover has been designed.

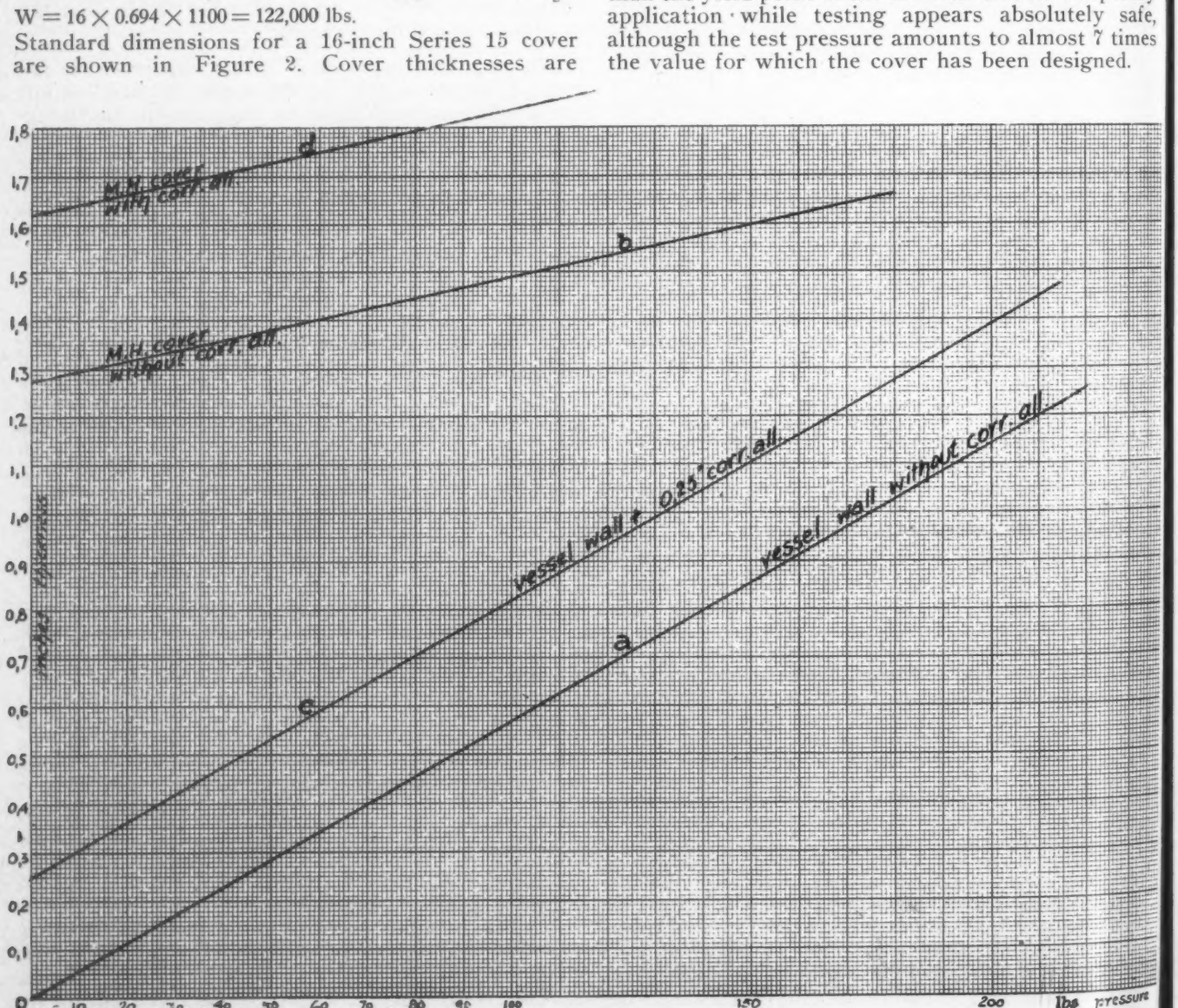


FIGURE 1

A similar condition exists in all cases where corrosion allowance has to be added. The corresponding lines are shown in Figure 1 as lines c and d, for c.a.¼-inch. The additional thickness added to the cover will largely allow for the increased a.w.p. in a shell wall that contains corrosion allowance. In this case a cover designed for internal pressure will carry still lower stresses during the hydrostatic test than the cover in above example, all the other conditions being the same.

In figuring the thickness of a flat cover plate it is usual to apply this working stress times the number and the mentioned standard diameter of the bolts in order to find the total bolt load in pounds. The resulting W becomes exceedingly high, by far higher than necessary to stand the actual operating conditions. Using the formulae mentioned before, the computed value of the cover thickness exceeds considerably what may be called appropriate from a viewpoint of safety and economy. It is easy to be seen that such

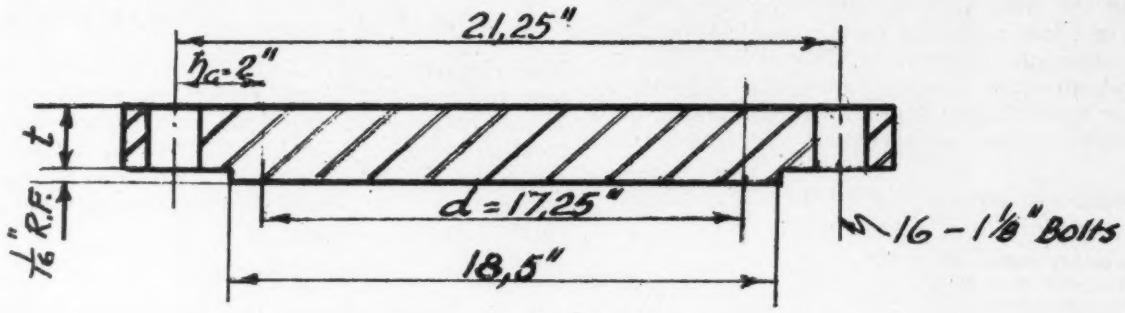


FIGURE 2

Taking similar views as in designing manhole covers some designers are inclined to figure reinforcing pads for shell openings on the basis of an a.w.p. derived from a shell made extra strong to stand wind load, impact loads or the mentioned localized stress. The resulting reinforcement rings are often by far too heavy, quite out of proportion with the actual operating pressure of the vessel. Also here a sensible interpretation of the code may help to avoid waste of material and labor. Whenever a shell, for structural reasons, is to be made heavier than required for internal pressure, it appears unnecessary to design shell openings for an a.w.p. derived from the combined stresses in the shell. These details are not subject to the additional structural stresses, they should, consequently, be dimensioned to the internal design pressure only.

A Suggestion Regarding the Bolt Load

Under point f of par. W-316 of the API-ASME Code the total bolt load "W" determining the thickness of a cover plate is defined as the product of A_B, the total cross sectional area of the bolts taken at the root of the thread, times S_B, the maximum allowable unit working stress in the bolt. It is common practice to use the standard number and diameters of bolts and studs as given by Taylor Forge & Pipe Company and other companies in their catalogs for forged flanges of all kind. These bolt diameters, however, have obviously been figured for carbon steel bolts, admissible up to 450° F. operating temperature and allowing 11,000 psi. as design working stress according to point el of the cited paragraph.

Whenever the operating temperature exceeds 450 degrees and or the pressure exceeds 160 psi. (Par. W-205a) alloy steel bolting material to ASTM Specification A96 is to be used. For this material, combining a higher tensile strength with a lower creeping rate, a tensile strength of 100,000 psi at normal temperature is specified in revised paragraph 317 e 2 of the API-ASME Code. Assuming a safety factor of 5 for bolts (higher than the S.F.=4 generally applied in the API-ASME Code) the design working stress for such bolts for ferrous materials is S_B=20,000 psi.

(*) Modern Flange Design, 2nd edition 1941, Bulletin No. 42[illegible]

a design procedure, as really applied on a large scale on hundreds of vessels, must result in waste of materials and labor, highly undesirable under the strain of war time.

The information and calculation methods given by the Taylor Forge & Pipe Works* are much better suited to bring about an understanding of the factors involved than the code itself. In order to avoid overbolting and over-dimensioning of the flanges it is recommended to figure the bolt load required for operation

$$W_{min} = \frac{\pi G^2 \pi}{4} + 26\,\pi Gmp$$

and the bolt load sufficient to yield the gasket in a cold condition

$$W_{min} = 6\,\pi\, Gy$$

Dividing by the allowable bolt stress at the relative temperature two different values are found for $A_{B\,min}$ and the greater of both is selected. Considering a possible abuse in tightening the bolts a higher value $A_{B\,act}$ had been previously recommended for designing the flange. It may be assumed that most designers used to base their $A_{B\,act}$ on bolt diameters specified in standard flange tables, thus obtaining much heavier bolts and flanges than necessary. To meet some objections to this practice, Taylor Forge are suggesting the following rule as a compromise:

$$W = \frac{A_{B\,min} + A_{B\,act}}{2} \times S_{op}$$

If standard bolt diameters are used—and that is advisable by practical reasons of standardization—it is not clear why the use of alloy bolts instead of carbon-steel bolts under otherwise equal conditions should result in proportionately higher stresses in the flanges. In both cases the bolt load applied to obtain a reliably tight joint appears to be the same. As a logical consequence, the required flange dimensions should be the same. It will appear that the discrepancy originates in the formulation of W-317 points e and f, which stipulate that S_B be the maximum allowable working stress of the bolting material used.

In the majority of cases the bolt pull calculated from the actual bolt area $A_{B\,act}$ is considerably higher than $A_{B\,min}$ figured for the actual load. In other

words, the a.w.s. for the bolts will most probably never be reached in practical operation. But should it be reached, the safety factor=4 affords a large enough security to warrant safe operation.

It appears logical and safe to design the flange for a bolt load based on carbon-steel bolts, even when alloy-steel bolts are used. Similarly as expressed in par. W-317 e 2 the stress allowed at temperatures over 450° F. could be determined by applying the reduction factors for forged steel, given in the chart, Figure 1, of the code, to a tensile strength of 44,000 psi. which is a low value for carbon-steel bolts. The additional strength inherent in alloy-steel bolts at normal and elevated temperatures will furnish a safety factor much higher than 4, thereby taking care of an eventual abuse occurring in tightening the bolts.

An example will serve to clarify the above suggestions:

Welded pressure vessel, $D_m = 60''$
design pressure $p = 300$ psi
design temperature = 750° F.
corrosion alowance $c = \frac{1}{4}$-inch
plate material to A.S.T.M. spec. A 70 flange quality; vessel to be radiographed and stress relieved. A 16-inch Series 30 manhole to be used, made of the same plate material as the vessel.

Data for Manhole: $d_g = 18.5''$; $d = 17.25''$; $h_g = 2.63''$
20 studs $1\frac{1}{4}''$ (according to standard flange tables)
Temperature factor 0.21

Shell Wall: $$T = \frac{300 \times 60}{27{,}500 \times 0.21 \times 0.92} + 0.25 = 1.097''$$; take $1\frac{1}{8}''$

a.w.p. when new and cold $$p_n = \frac{1{,}125 \times 27{,}500 \times 0.92}{60} = 475 \text{ psi.}$$

Operating

bolt load $W_{op} = 20 \times 0.893 \times 44{,}000 \times 0.21 = 165{,}400$ lbs.

$$H_{op} = \frac{18.5^2\pi}{4} \times 300 = 80{,}600 \text{ lbs.}$$

$$C_{op} = 0.3 + \frac{1.4 \times 165{,}400 \times 2.63}{80{,}600 \times 17.25} = 0.3 + 0.438 = 0.738$$

Cover thickness

$$t_{op} = 17.25 \sqrt{\frac{0.738 \times 300}{55{,}000 \times 0.21}} + 0.25 = 2.39 + 0.25 = 2.64''$$

take $2\frac{5}{8}''$

When new and cold:

$$W_n = 20 \times 0.893 \times 44{,}000 \times 0.25 = 196{,}400 \text{ lbs.}$$

$$H_n = \frac{18.5^2\pi}{4} \times 475 = 127{,}500 \text{ lbs.}$$

$$C_n = 0.3 + \frac{1.4 \times 196{,}400 \times 2.63}{127{,}500 \times 17.25} = 0.3 + 0.329 = 0.629$$

thickness required for test

$$t_n = 17.25 \sqrt{\frac{0.629 \times 475}{13{,}750}} = 2.54''$$ (is smaller than $2\frac{5}{8}''$)

For a comparison, the manhole cover based on alloy bolts is figured:

$$W_{op}' = 20 \times 0.893 \times 100{,}000 \times 0.21 = 375{,}000 \text{ lbs.}$$

$$C_n' = 0.3 + \frac{1.4 \times 375{,}000 \times 2.63}{80{,}600 \times 17.25} = 0.3 + 0.993 = 1.293$$

$$t' = 17.25 \sqrt{\frac{1.293 \times 300}{55{,}000 \times 0.21}} + 0.25 = 3.16 + 0.25 = 3.41''$$

The figured value of 3.41-inch probably will be rounded up to 3.5-inch, which means that a cover $\frac{7}{8}$-inch thicker than if based on carbon-steel bolts had to be used, showing clearly the advantage in using the suggested design procedure without abandoning the principle to obtain a tight joint and a sufficiently strong cover.

Summary

It has been attempted in this paper to demonstrate that the conception of both codes, the test pressure had to be based on the full wall thickness of a vessel containing auditions over a thickness necessary to stand the internal design pressure, leads many designers to "overdimensioning" parts of shell openings. This is particularly true with regard to the API-ASME Code ruling that the longitudinal weld of a vessel be given the full test pressure proportional to its thickness after completed construction. It is emphasized that thickening such parts as manhole covers and reinforcing pads just to let them match a temporarily applied test pressure appears as an unnecessary expenditure, particularly when the stress in the engaged parts remains under the yield point of the material. Further, it is questioned if the use of alloy bolts justifies the design for a higher value than that for carbon-steel bolts for the bolt load applied to achieve a tight joint. In the interest of conserving material and labor these questions are brought to the attention of the interested parties, especially so to the API-ASME committee on unfired pressure vessels and to the insurance companies in charge of inspections.

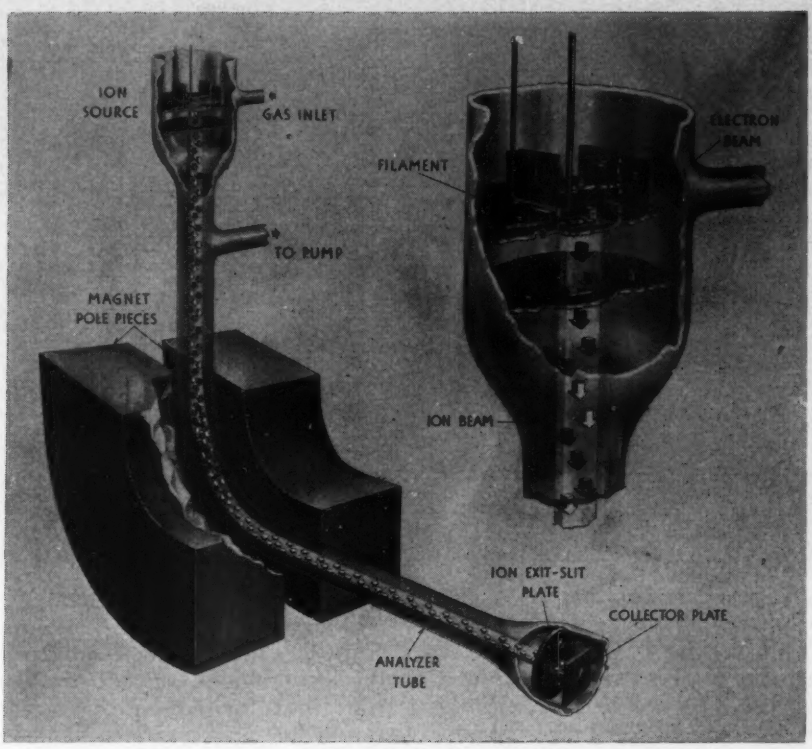


FIGURE 1
Mass Spectrometer Tube

The Mass Spectrometer for Gas Analysis

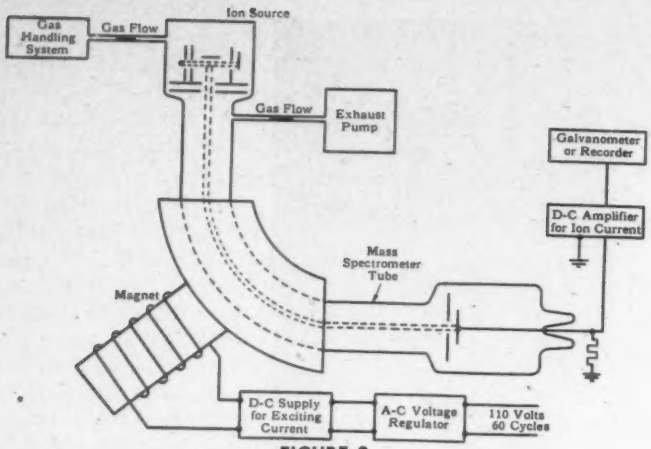
JOHN A. HIPPLE, Research Laboratories, and
H. E. DRALLE, Manager of Petroleum and Chemical Engineering,
Westinghouse Electric & Manufacturing Company

THE suddenly developed need for high-quality aviation gasoline, synthetic rubber, explosives, and other important materials having a vital relation to the success of the war effort gave impetus to the task of finding improved means for quickly and accurately determining the purity of constituents forming a part of these products. For making these determinations such methods as pressure distillation, solvent extraction, fractional crystalization, infrared and ultraviolet absorption, and others of less importance, have been employed with varying degrees of success. But all possessed shortcomings of one type or another that accelerated the search for new analytical instruments, particularly one that would facilitate making analyses of complex hydrocarbon mixtures. Such an instrument is the mass spectrometer.

The mass spectrometer, as the name implies, is an instrument in which ion streams of different masses can be separated and measured in a manner that permits both qualitative and quantitative measurement of the components of a gas mixture. It is essentially a high vacuum tube into which this gas to be analyzed is admitted and ionized. By closely controlled electrical and magnetic fields, the ions are caused to move through the tube so that each stream of ions of different mass can be successively focused on an exit slit at the end of the tube where they impinge upon a plate and give up their charge. This charge or current is amplified and measured by electrical instruments. From these electrical readings the exact composition of the gas mixture is readily obtainable.

The vacuum tube with ionization chamber and the magnetic pole pieces are shown in detail in Figure 1. A schematic diagram of the mass spectrometer with the more important components are shown schematically in Figure 2(a). The gas to be analyzed is pumped through the ionization chamber through the zone where the electron beam is defined and is ionized by the impact of the electrons on the gas molecules. The ions thus formed just below electrode 4 are driven by a small potential difference between 4 and 2, Figure 2 (b), through the long slit in electrode 2, forming an ion beam. This ion beam is then accelerated by a much larger potential difference between 2 and 5, the latter being at ground potential. Passing through the slit in 5, the narrowly collimated beam enters the analyzer region of the tube which has a grounded metallic shield on the inner surface.

Thus far the beam contains all the ions formed by



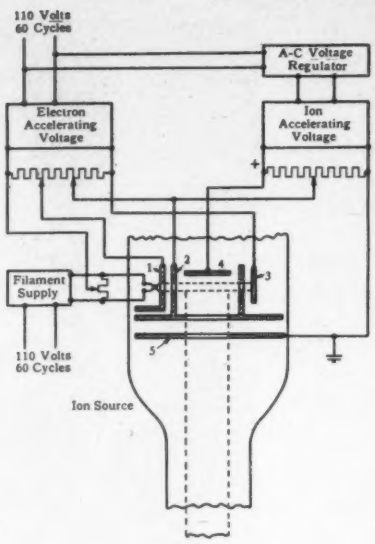


FIGURE 2
Diagrammatic view of Elements of Mass Spectrometer:
Above—General View.
Right—Close-up of Connections at Ionizing Source.

the electron beam bombarding the gas mixture in the ionization region. Ion separation begins at the point where the ion beam enters the region between the pole pieces of the elctromagnet. As the magnetic field in this gap is perpendicular to the direction of the motion of the ions, the ions are bent in circular paths—all ions of any given mass (assuming all ions singly charged) receive the same deflection but different masses obviously have different radii of curvature. The lighter the ion mass the smaller will be the radius of curvature of its path. If the accelerating potential and the magnetic field are adjusted so that the ions of a particular mass are focused on the exit slit, lighter ones strike the tube on the upper side of the main ion stream and heavier ones on the lower side, where both are drained to ground. By adjusting the magnetic field or the accelerating potential, or both, the ion streams of different masses can be successively focused to pass through the exit slit of the tube and impinge upon a collecting electrode where their charge is given up. The current reaching this electrode is amplified and measured; its magnitude in each case being a measure of the number of molecules in this species in the mixture.

A typical analysis to determine the amount of oxygen and nitrogen in that common gas mixture, air, illustrates the functioning of the apparatus. First a blend of oxygen and nitrogen of any convenient but carefully measured proportions is prepared and allowed to flow through the mass spectrometer tube as indicated schematically in Figure 2. This blend of nitrogen and oxygen is used as a standard. Ions of both nitrogen and oxygen emerge from the ionization chamber into the analyzer. The fields are adjusted so that mass 28 (nitrogen) is focused on the exit slit of the mass spectrometer and the current measured. Mass 32 (oxygen) being heavier is not deflected as much by the magnetic field and is lost on the grounded interior of the analyzer. The fields are then readjusted so that the current corresponding to mass 32 may pass through the exit slit and be measured. The nitrogen ions are obviously deflected more (have a shorter radius of curvature) and are lost on the grounded shield. The instrument is now calibrated for nitrogen and oxygen in any proportions, and if air is allowed to pass through the mass spectrometer we can quantitatively determine the composition from the current readings obtained when the conditions have been set so that nitrogen ions and oxygen ions produce successive readings. In other words the patterns of the unknown mixture are compared with the known standards.

There may be some question about the extension of these calibrations to mixtures in which the relative proportions of constitutents are far removed from that for which the calibration was made. It should be appreciated that the ion current corresponding to a particular substance in a mixture varies directly as the partial pressure of that substance in the mixture. The mean free paths (the average distance which one molecule traverses before striking another molecule) of both electrons and ions are long compared with the dimensions of the apparatus. Thus, the probability of interaction between molecules or of multiple collisions by an electron are small, because the gas to be analyzed flows through the instrument continuously during the analysis and the pressure within the system is of the order of one ten-millionth of an atmosphere.

The spectrometer can work on very small amounts of gas, an important condition where samples for analysis must be sent to a central laboratory remote from the point of origin. The gas-handling system is arranged so that there is a continuous flow of gas through the tube at all times, but this flow is only of the order of one ten-thousandth cubic centimeter per minute at atmospheric pressure.

The electron current in the beam responsible for the gas ionization is in the order of 10 microamperes (one one-hundred-thousandth of an ampere). The ion current emerging from the exit slit is between one ten-thousandth and one billionth of a microampere (a microampere is one millionth of an ampere) depending upon the mixture being analyzed. The current in the antenna of an ordinary radio receiving set is about one microampere. When it is realized the currents that must be amplified and recorded in the mass spectrometer may be one billionth of this, some conception is had of the degree of sensitivity of the instrument in detecting minute quantities of any substance in a mixture. It is of interest that as little as one part of oxygen in ten thousand parts of nitrogen has been detected and this is not the limit of the sensitivity of the instrument.

In a typical instrument the radius of curvature of the ion beam is between 10 and 15 centimeters. The ion accelerating voltage is approximately 1000 volts, d-c, and the electron accelerating voltage is less than 100 volts, d-c.

The spectrometer, which consumes about 15 kw,

FIGURE 3
Latest type of Mass Spectrometer.
Left, side view with cover open; middle, front view showing operating panel; right, close-up of gas flow valve.

operates from any 110-volt, 60-cycle alternating-current source. An a-c voltage regulator is used to stabilize the line voltage. The power packs supplying direct current for energizing the magnet and for accelerating the ions are vacuum-tube regulated and these voltages are constant to 1 part in 10,000.

Accuracy of the instrument is affected by humidity and temperature but special precautions to maintain these factors fairly uniform are necessary only in regions where high humidity (above 50 to 60 percent) is encountered. Under such climatic conditions or where extremely accurate laboratory work is required, an air-conditioned room is desirable.

In discussing the applications of the mass spectrometer it should first be appreciated that most of the problems of interest today are not as simple as the example of oxygen and nitrogen used above for illustration. Even in that example there are other masses present that were not mentioned. There are two isotopes of nitrogen (elements having the same chemical properties but different atomic weights), N^{14} (mass 14) and N^{15} (mass 15), the latter being roughly one percent of the former. Thus, the largest peak present is mass 28, formed by the ion $N^{14}\ N^{14+}$. (The plus sign indicates that this is a positively charged molecule—in other words an ion.) However, there is a weak peak at mass 29 ($N^{14}\ N^{15+}$) and an extremely weak one at mass 30 ($N^{15}\ N^{15+}$). For the use of N^{15} as a tracer in chemical or biological studies the mass 29 peak would be of importance. A tracer is used as a means of tagging, and later identifying, particular atoms in reactions or processes in which other atoms of the same element are present, in order to trace the course of this element throughout the process without changing the nature of the reaction. All of these peaks are formed by simple ionization of the nitrogen molecule by electron impact. When the electron hits the nitrogen molecule it may split (dissociate) the molecule producing an atomic nitrogen ion. Considering only the more abundant isotope N^{14} the simple ionization gives a peak at mass 28, whereas the combination of dissociation and ionization gives a peak at mass 14. Thus

$$N_2 \rightarrow N^+_2 + e^- \text{ (ion of mass 28)}$$
$$N_2 \rightarrow N + N^+ + e^- \text{ (ion of mass 14)}$$

where e^- represents the electron ejected in the reaction. In this case simple ionization is far more probable; i.e., the ion current corresponding to mass 28 is much larger than that at mass 14.

In some cases it is more probable to dissociate the molecule by electron impact than it is simply to ionize it. This is particularly true of hydrocarbons. For instance, in normal butane ($C_4\ H_{10}$) with a parent mass at 58, the largest mass ($C_3\ H_7$) in the spectrum, is at mass 43. Thus

$$C_4\ H_{10} \rightarrow C_4\ H_{10}^+ + e^- \text{ (ion of mass 58)}$$
$$C_4\ H_{10} \rightarrow C_3\ H_7^+ + CH_3 + e^- \text{ (ion of mass 43)}$$

A great deal of study has been made in recent years on the energy of the electron beam at which these various fragments appear, and it has been possible to correlate these results with thermo-chemical data. In a molecule like normal butane, with a large number of component atoms, many masses are present in the mass spectrum due to the dissociation of the molecule by electron impact. A portion of the isobutane spectrum is shown in Figure 4. This spectrum can be obtained by continuously varying either the ion accelerating voltage or the magnetic field. This so-called "cracking pattern" is helpful in an analysis of a mixture of normal butane and its isomer isobutane. (Isomers are compounds having the same molecular weight; they are composed of the same elements united in the same proportion by weight, but differing in one or more properties because of difference in structure.) Since the cracking patterns of these isomers differ, an analysis can be made in spite of the fact that both parent masses are the same. In the region shown on the record the successive masses result when a successively greater number of hydrogen atoms are split from the parent ion, $C_4\ H_{10}$. The peak at mass 59 is contributed by the heavy carbon isotope C^{13}. In other cases the cracking pattern causes complications because the butanes contribute masses at all points in the mass spectrum at which hydrocarbons of lower mass would appear. For instance, an analysis of a mixture of normal butane and butadiene ($C_4\ H_6$ with the parent ion as mass 54) would require that we first subtract the contribution to mass 54 from the normal butane; the remainder of the current at mass 54 is then contributed by the butadiene. As all the equations are linear, this problem

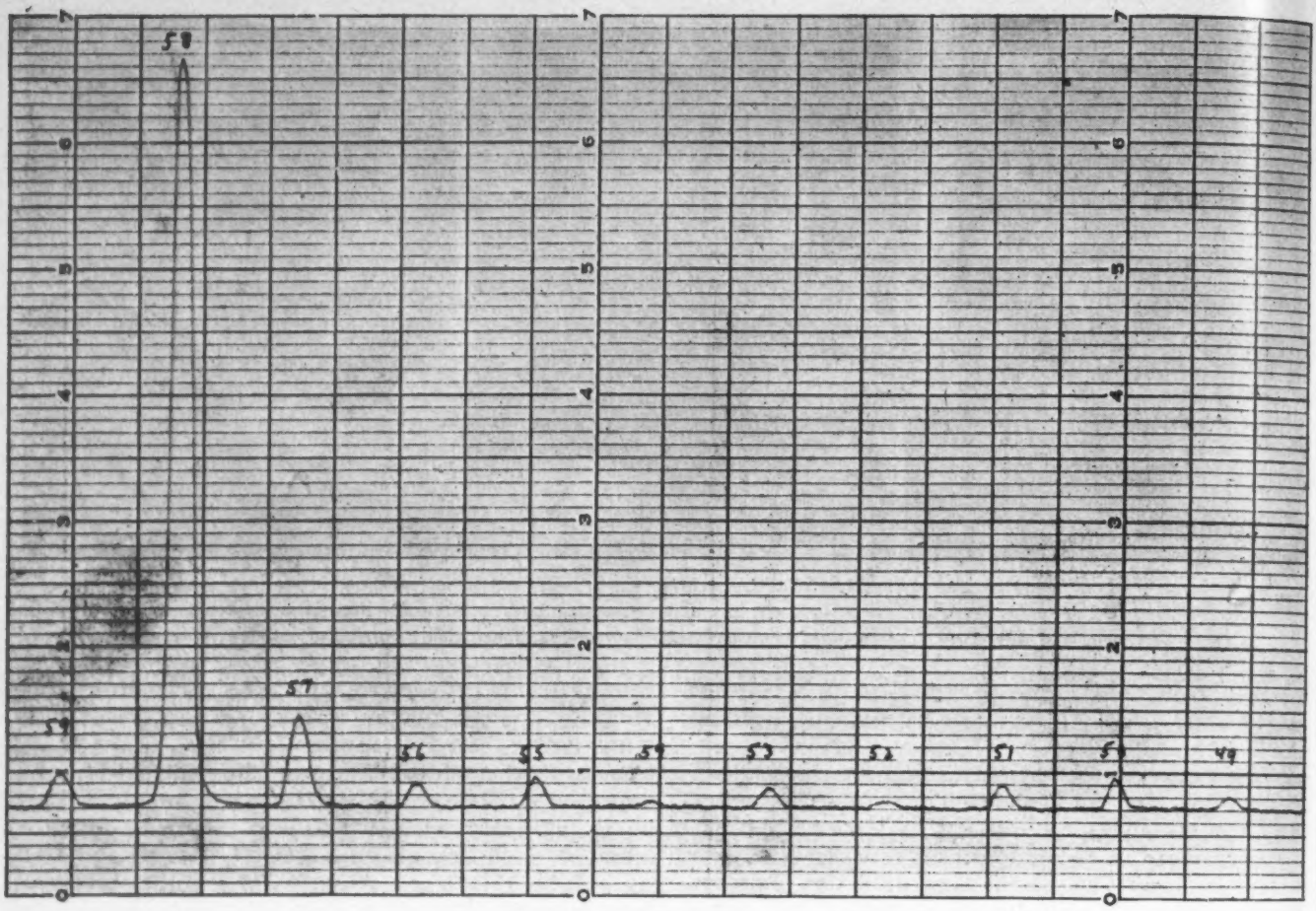


FIGURE 4
Portion of the Spectrum of Iso-Butane

can be set up mathematically and solved readily for a fairly complicated system.

Clearly the mass spectrometer is an extremely useful tool for analyzing hydrocarbons for impurities of higher molecular weight than the main components because there is no conflict in masses, and the impurities stand out uniquely. It is also generally true that hydrocarbon analysis by the mass spectrometer becomes most difficult when the components have the same or nearly the same molecular weight.

TABLE 1
Analyses of Hydrocarbon Blends

Component	PERCENT OF TOTAL				
	Blend 1	Blend 2	Blend 3	Blend 4	Blend 5
i-C_4H_{10}					
Synthetic	22.4	41.6	....	24.4	51.9
Mass Spectrometer	23.4	41.7	....	24.0	52.0
n-C_4H_{10}					
Synthetic	25.4	41.2	....	14.2	48.1
Mass Spectrometer	26.1	41.4	....	13.7	48.0
-C_4H_8					
Snythetic	26.2	....	3.7	....	....
Mass Spectrometer	25.3	....	4.1	....	....
cis- -C_4H_8					
Synthetic	....	....	18.3	25.6	....
Mass Spectrometer	....	....	20.0	26.6	....
trans- -C_4H_8					
Snythetic	....	....	31.1	....	....
Mass Spectrometer	....	....	28.6	....	....
-C_4H_8					
Synthetic	26.0	....	....	28.8	....
Mass Spectrometer	25.1	....	....	28.6	....
1, 3-C_4H_6					
Synthetic	....	17.2	46.9	7.0	....
Mass Spectrometer	....	16.9	47.3	7.1	....
Air					
Synthetic	0	0	0	0	0
Mass Spectrometer	0.30	0.42	....	0.16	0.49

Analysis of synthetic blends comparing known values of the samples with those determined by the mass spectrometer.

The results achieved in quantitative analysis of five blends of hydrocarbon gases are shown in Table 1. The blends were synthesized by a third party, and the findings, when using the mass spectrometer, are compared in each instance with the actual amount of the gaseous component in the blend. This is typical of the operation of the mass spectrometer when resolving masses of nearly the same molecular weight. In this example, all the parent masses appear at the three mass numbers 54, 56, 58. The addition of components to this mixture having masses somewhat removed from these would not, in general, have complicated the analyses.

The problem of hydrocarbon analyses has been discussed at some length not only because it is a difficult one, but also because in this field of analysis it is immediately applicable to the synthetic rubber and aviation gasoline programs.

The value of the spectrometer as an analytical tool in the analysis of hydrocarbons alone well justifies its development. However, already in evidence are other promising fields of application, such as leakage testing, outgassing of vacuum equipment, metallurgical analyses, purity of controlled furnace gases, automatic controls of processes where it may be important to measure the relative quantity of a desired constituent or to detect presence of an undesirable element and so on. Any of these applications might conceivably require simpler and consequently less expensive instruments than the ones now used for analyses in laboratories.

The Synthesis of Gasoline by The Fischer-Tropsch Process

PART I

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Translated from Brennstoff-Chemie Vol. 13, No. 4, 1943

SINCE presenting the last comprehensive report on the development of synthesis of gasolines by the water-gas reaction[1] considerable new data has been obtained on further perfecting this process. These reports comprise the methods to utilize various gases, preparing more active catalysts, describe more fully the mechanism of the reactions, and the properties and uses of the products obtained. Below are found the literature references to date concerning such reports published since 1931:

Contributions in 1931-32

1. F. Fischer and Karl Meyer: The Uses of Nickel Catalysts in the Synthesis of Gasoline. Brennst.-Chemie. 12, 225 (1931).
2. S. H. Kodama—K. Fujimura: The Catalytic Reduction of Carbon Monoxide at Ordinary Pressure; the Influence of Alkalies on the Iron-Copper-Catalysts. Journal So. Chem. Indus. Japan 34, B. 14 (1931).
3. K. Fujimura: Catalytic Reduction of Carbon Monoxide at Ordinary Pressures; IX. Further Tests with Cobalt-Copper-Magnesium Oxide Catalysts. Journ. Soc. Chem. Indus. Japan 34, 227B (1931).
4. R. Muller: Tentative Tests to Produce Petroleum Hydrocarbons from Carbon Monoxide and Hydrogen at Ordinary Pressure. Ingeniors Vetenskap Acad. Handlinger No. 6, Stockholm (1930).
5. M. G. Levi, C. Padovoni, M. Busi: Syntheses of Hydrocarbons from Carbon-Monoxide-Hydrogen Mixtures at Ordinary Pressures. Studi e Ricerche sui Combustible 2, 213 (1927-29).
6. Franz Fischer-H. Koch: Further Developments on Testing Cobalt Catalysts for the Benzine Synthesis. Brennst.-Chemie 13, 61 (1932).
7. K. Fujimura: The Catalytic Reduction of Carbon Monoxide at Ordinary Pressure. X. Tests on Some Materials Which Influence the Action of the Cobalt-Copper-Magnesium Oxide Catalysts. Jour. Soc. Chem. Industry, Japan 34, 384B (1931).
8. H. Koch-Otto Horn: Comparative Investigations of Motor Performances of Fischer-Tropsch Gasoline and a Petroleum Gasoline. Brennst.-Chem. 13, 164 (1932).
9. R. Hartner-Seberich, H. Koch: The Uses for High Boiling Diesel-Fuel (Kogasin II) from the Fischer-Tropsch Process. Brennst.-Chem. 13, 308 (1932).
10. K. Fujimura: The Benzine Syntheses at Ordinary Pressure. XI. Jour. Soc. Chem. Indust. Japan 35B, 179 (1932).
11. Alfred Schaarschmidt-M. Marder: Synthetic Gasoline from Water-Gas. Brennst.-Chemie 13, 412 (1932).
12. F. Fischer-H. Pichler-R. Reder: A Review of the Value of Various Carbon-Monoxide-Hydrogen Mixtures in the Benzine Synthesis Brought Up to Date. Brennst.-Chemie 13, 421 (1932).
13. F. Fischer-H. Koch: The Mechanism of the Benzine Synthesis & Tests of the Motor-Fuel & Other Products; Gas-oil, Diesel-oil, Hard Paraffin Wax, Etc. Brennst.-Chemie 13, 428 (1932).

The above cited reports deal with data based on laboratory results. Many new advances are described therein and new improvements are cited. The object of these researches, however, is to apply the data for commercial installations to carry out economically the benzine-synthesis and there is apparently lacking in these reports the important factor of seeking an efficient contact apparatus, and the construction details for actually carrying out the reaction. Our publication[1] overlooked the further necessity of finding a sound engineering principle for constructing true reaction vessels, and that somehow or other an economical apparatus could be built when the time arrived for large-scale set-ups.

After a year's study on the subject of apparatus, we finally believe we have a basis for discussing our results on the construction of contact apparatus, among other items, such as gas mixtures, temperatures, catalysts, etc. We have now developed a technically sound, cheap and simple contact chamber which has lasted through months of continuous service. With that the benzine synthesis has entered a new phase. We therefore will describe our approach to the whole subject of syntheses and the conditions under which the water-gas reaction is used to produce gasoline and a series of valuable hydrocarbon by-products.

The Raw Gases Used in the Reaction

The composition of the gases is a very important item in technical or large-scale operations, and we present our data and experiences of large-scale operations, as it concerns the first item—the composition of the gas to be used.

(A) Relative ratios of $CO:H_2$. The stoichiometrical mixture which contains 33.3 percent carbon monoxide and 66.6 percent hydrogen would be the most desirable one. It undergoes the reaction at highest of any of the water-gas reaction rates and furnishes maximum yields of products per cubic meter of raw gas—based on volume—time of contact basis. Besides, this mixture of above ratios secures the greatest "degree of conversion" to liquid hydrocarbons. The "degree of conversion" is that percent of carbon monoxide consumed which is converted to liquid and solid hydrocarbons.

The reaction-rate becomes smaller when the mixture contains more carbon monoxide than called for by stoichiometrical relations. The content of liquid products increases as does the unsaturation of these products. A greater content of hydrogen in the mixture than the theoretical quantities calculated for results in a greater quantity of gaseous products, more saturation, and the conversion is more rapid.

This influence of the content of the raw gases on the whole reaction can be minimized, so to speak, to some degree by choosing a specific reaction-temperature which is optimum for one or the other of the reacting gas components—and this temperature is higher for carbon-monoxide-rich gases, and for hydrogen-rich gases lower temperatures are selected.

(B) The Concentration of the Reactants. Any dilution of the carbon-monoxide-hydrogen gas mixture results in a rapidly reduced rate of reaction. Gases which are inert in the benzine synthesis reaction, such as nitrogen, carbon dioxide, methane, etc., when present in the raw gases also act as diluents. A similar "diluting" action is also shown by the by-products of the reaction, namely, water-vapor, methane, ethane, etc. The more dilute the stoichiometric $CO:H_2$ mixture, the smaller will be "volume-time" yield. We shall indicate the degree of influence on yields, etc., further on in our discussion.

Our sources of gases rich in carbon dioxide and hydrogen are two: first, we can produce from coke and steam 100 cubic meters of water-gas per hour in a generator, or secure coke-oven gases from the commercial lines. Further, we can obtain "cracking gas" from this coke-oven gas by conversion of the methane contents of the latter with steam. Such a "methane splitter" is shown in Figure 1.

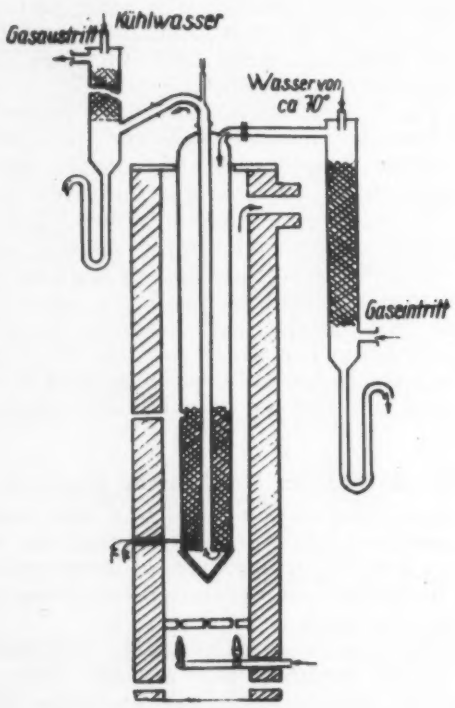

FIGURE 1
Methane Splitter

This apparatus in which this splitting or cracking takes place consists of a vertical reaction-chamber three meters long and cylindrical in shape. It withstands extremely high temperatures and is made of nickel-chrome steel. The cylinder is filled about one third up from the bottom with pieces of catalyst consisting of porous plates containing the impregnated catalyst mass—nickel-aluminum.[2] The vessel is externally heated with gas flames to 950-1000° C. We employed a cobalt catalyst in our first trials. It was discovered that the high temperatures vaporize cobalt and was rapidly leaving the chamber in the exit gases. The nickel-chrome apparatus is so heated as to prevent overheating and prolong the life of the metal. Constructed as shown in Figure 1, and using the nickel-aluminum catalyst described above, the apparatus has lasted several years now and given good service.

Unfortunately the method of splitting coke-oven gases separately is not feasible on a very large scale due to the high cost of the special steel apparatus, and the sensitiveness of the whole splitting-reaction. Since, however, the use of coke-oven cracking-gases appear to be a very good source of the two necessary reactants, we thought it therefore very worthwhile to conduct the cracking and simultaneously feeding in our water-gas—as might be done in our 100-cubic-meter generator already described. The procedure was recently described by Fischer, Pichler and Reder.[3]

In our early work on the benzine synthesis we were able to use technically available gases (water-gas and coke-oven gas) always constant in composition. Since 1930, at the suggestion of one of us (Roelen) we started to employ raw gases in mixed form, and in various mixtures. The gases were so mixed as always to secure the content of carbon monoxide and hydrogen in stoichiometrical ratio.

Table 1 describes the two gases we have employed in the following work to be described.

TABLE 1
Composition of the Raw Gas

Mixed Gas	Derived From	Average Composition in Vol.—Percent						
		CO_2	Heavy Oils	O_2	CO	H_2	CH_4	N_2
24/48*	50 vol.-percent of Coke-oven gas + 50 vol.-percent water-gas.....	2.8	1.1	0.2	24.7	48.4	12.2	10.5
28/56*	50 vol.-percent of cracked gas (from 33 percent—[by vol. coke-oven gas] + 50 vol.-percent of water-gas).....	2.6	0.0	0.0	27.9	57.8	2.0	9.7

* These 2 Figures indicate the content of the raw gases of carbon monoxide and hydrogen and are abbreviated figures to be used throughout our description of the gases employed.

(C) Purification of the Raw Gas. Before the mixed gases go to the converters they must be freed of all sulphur and its various derivatives, which we have described previously.[4]

The raw gas is treated with iron oxide—the so-called purification mass—to remove all traces of hydrogen sulphide. The sulphur derivatives still remaining are next removed by a two-step contacting of the gases with iron heated to 400° C. and cooling in between. Here again the sulphur compounds form hydrogen sulphide. The latter is removed after the first stage with iron oxide mass, and after the second stage by washing with alkaline potassium ferricyanide solution.

The Catalysts

When the cracked gases are used, made from coking gases, the heating period in the "methane cracker" serves as the first purification step. Thence the water-gas is simultaneously led into the methane cracker.

More recently we purified the gas (24/28) in both contacts by heating in a pipe-coil system at 400° F., over iron filings. The sulphur is more readily removed and the later catalytic reaction is speeded up. The gases are pure to the extent of 0.2 grams of sulphur per 100 cubic meters.

We are aware of the cost of such double heating in this purification system—that is as high as 400° C. temperature. Nevertheless, we have found the method reliable and quite practical, though we still know a cheaper procedure will eventually be evolved.

After we discovered the superiority of nickel catalysts over our earlier cobalt catalysts, we have employed the former almost exclusively. This catalyst has been used throughout this work—namely, a normal catalyst consisting of the oxides of nickel, manganese and aluminum laid down on kieselgur.

To prepare this catalyst, to a solution of 250 parts of nickel nitrate (6 mols. water), 50 parts of manganese nitrate (6 mols. water), and 34 parts of aluminum nitrate (9 mols. water) in 600 pts. distilled water there are added in the cold 60 parts of kieselgur.[5] There is next added a solution of 210 parts anhydrous potassium carbonate in 600 parts of distilled water and the precipitate which forms (plus the whole solution) is brought to a boil and filtered from the liquor. The precipitate is washed with 600 parts of hot water, and is dried in an air-stream at 110° C.

For laboratory purposes the dried mass is best ground to a powder in a mortar in order to obtain reproducible results. In that case it is used as a fine powder. Commercially, the coarse dried material is preferred due to ease of handling when used in non-moving contact. Coarse pieces or granules also allow a rapid penetration of the gases.

We have found that a practical form of granules is very useful and this form is prepared as follows. The precipitate after washing is thoroughly pressed on the plate filter and is dried in the form of large pieces. Upon crushing, the pieces break-up along the surface where the drying or pressing took place, and very little powdered material was formed during the crushing process. In all our commercial installations we employed the lump form to real advantage. The efficiency of this catalyst in pilot-plant work is now to be described.

Table 2 below shows the yields obtained when passing 4 liters of gas per hour through a glass tube 15 mm. internal diameter over a long layer of the catalyst in the tube—placed to a length of about 30 cm.; the catalyst quantity used was calculated to contain 4 gm. metallic nickel.

TABLE 2

Yields with Nickel-Manganese-Aluminum-Kieselgur Catalyst

	FLUID PRODUCTS—Per Cubic Meter					
	Initial Stage		After 4 Weeks		Average	
From Gas	CC.	GMS.	CC.	GMS.	CC.	GMS.
24/48	110	77	90	63	100	70
28/56	130	91	110	77	120	84

The optimum temperature is 190° C. at the initial part of the run, and at the end about 210° C. After a time large quantities of hard paraffin are formed on the catalyst, and can be extracted from the contact mass with benzene. The valuable wax is recovered but the extraction does not regenerate the catalyst. To accomplish this regeneration it is reduced at 450° C. in a current of hydrogen for about four hours. During the passage of the hydrogen it has been found that when 200 gm. gaseous ammonia are fed into the hydrogen the catalyst life is greatly increased.

After reduction the catalyst is again very active. Commercially we cannot predict when a new contact has to be put into use—it is usually 1-2 years very active—and with good purification of the gases the catalyst will last indefinitely.

Contacting Apparatus

It has already been mentioned that in practice the synthesis presented some difficulties due to holding temperature of reaction within controlling limits.[6] On the one hand, the prevailing temperature range is quite small (15° C.); on the other hand, the reaction being exothermic, the liberated heat is quite appreciable (about 450 small calories per cubic meter of 28/56 gas, or about 33,500 small calories per cubic meter of contact volume an hour). These thermal relationships are, however, not alone the factors which make the design of contact chambers difficult. More important are two factors which an apparatus must comply with in order to be practical:

1. The synthesis must proceed to completion based on the chemical reaction; the synthesis must also in the main produce benzine—and not proceed in directions making mostly by-products. To accomplish this it is necessary to maintain:
   (a) A constant temperature.
   (b) A complete and uniform distribution of the gas.
2. The synthesis must be able to proceed technically in a practical manner, and the apparatus must be fool-proof. To do this there is necessary:
   (a) Simple charging methods and emptying procedure in handling the catalyst.
   (b) The possibility for enlarging the apparatus.
   (c) Low initial and operating costs.

These two requirements make the problem of construction difficult. In 1929 our apparatus 28 and 35 was typical then[7] and gave excellent results and yields of fluid products. Its cost was too high. Subsequently we made a basic study and derived new principles to be guided by. For a while we worked with the idea to recirculate the gases in order to equalize reaction temperatures. This factor did not greatly aid our results but it led to a study of general recirculation of gases as was finally adopted.

In other types of catalytic gas reactions, for example, manufacture of ammonia from nitrogen and hydrogen, the operation is technically conducted to advantage so that the raw gases are pumped over the catalyst, go to the gas separator and from there are recirculated through the system. This was tried in our process also.

It had developed, however, that one can hardly employ this method in the benzine synthesis since the raw gases normally enter the chambers cold, and the exit gas is at a higher temperature (hot); both temperatures should be identical. The gases leaving the catalyst chambers are hardly able to absorb much more heat, even though large quantities are pumped around. However, the use of recirculating large quantities of hot gases back over the catalyst does aid in equalizing temperatures at the catalyst. The advantage, however, thus apparently gained is nevertheless small in comparison to the quantity of heat liberated. Recirculation (by pumping) does not appear to have any advantage over the procedure of ordinary flow of the gases through the chambers.

As it is, since part of the gases usually are led back over the catalyst, this gas mixture is a more or less diluted mixture of carbon dioxide and hydrogen at best. One had believed that the diluted gas might have been a good medium to prevent undue rise in the catalyst bed, but it did not prove to be such. For instance, assuming the space-time yield to remain fairly large and constant, then the same quantity of

heat has to be removed from the contact chamber (practically only through the tube or chamber walls) —whether the gases are diluted or not. The entering gases cannot absorb more heat and carry it on since they are limited to only 5° C. rise limits in the chamber. We discovered that the gases can only dampen the sharp rise in the reaction chamber as one would desire when they are so dilute as to be practically unreactive. (Tests with K21, Type K18.) An important conclusion can be drawn from this. On the one hand the raw gases must be readmixed in some manner; on the other hand, the exit gases are prone to be diluted in any case. With recirculation the yields are therefore lower, since with diluted gases the reaction-speed is considerably slowed down. In other words, the recirculation diminishes space-time yields. It is not advantageous to employ this method.

Tests With Catalyst Suspended in Oil

After several years work with dry catalyst in static condition we arrived, in 1930, at another method to solve our contacting problems. The finely powdered catalyst was suspended in the oil and allowed the gas to diffuse up through the suspension in a very finely divided condition. In the fat hydrogenation industry it is standard practice to regenerate with hydrogen nickel catalysts suspended in oil. It was desirous to note if the benzine synthesis could be conducted that way. For this purpose we led a known volume of gas from a gas holder through and back again from the receivers. This was done by means of a motor-driven centrifugal gas-dispersor or stirrer. The arrangement is shown below in Figure 2.

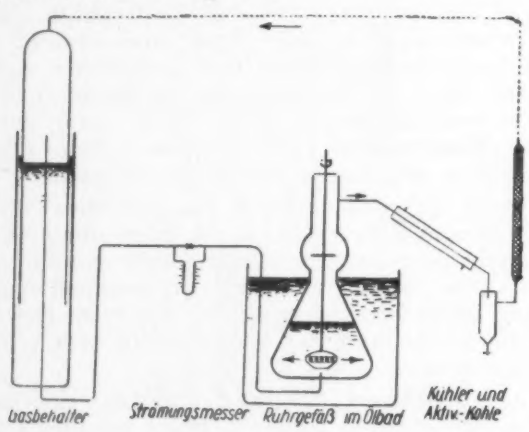

FIGURE 2
Stirring Apparatus

For suspension of the catalyst the oil used was a synthetic oil of B.P. 275-295° C.; cobalt-thorium and also various nickel catalysts were used. Blank tests with hydrogen showed no change. Using our carbon monoxide-hydrogen mixtures the yield of benzine and water, and also the volume contraction and analyses of the gases was in complete agreement with results obtained by the dry method. Due to the exceedingly efficient gas stirrer and distribution of gases into the oil, exact yields equal to those obtained in our glass tube apparatus were obtained per gram of catalyst. The relationship between speed of reaction and concentration of the gas mixtures could easily be observed in connection with the visible contraction of volume of the gas. Curve in Figure 3 shows that the concentrated mixture is rapidly reacting, while the last remaining portions of the CO:H mixture are only being slowly converted.

Actually used were 8 gms. Ni-Th catalyst on Kieselgur in 300 cc. of oil and 4.5 liters of fresh or new gas, recirculated at 50-100 liters per hour at 200° C. We could also repeat our results with flowing gas taken constantly from the gas-holder and obtain the same results.

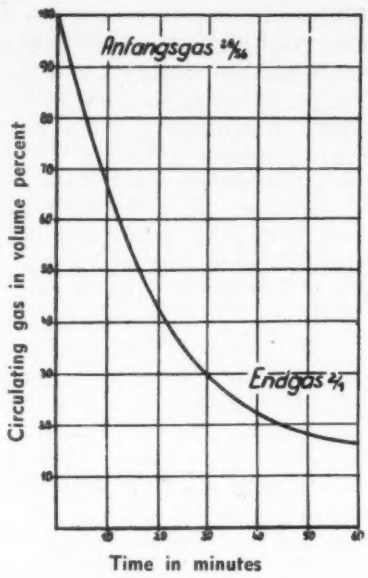

FIGURE 3
Effect of CO-H_2 Concentration on reaction rate

One disadvantage of using this type of stirrer is the high power consumption it entails in order to obtain high speeds and high gas dispersions in the oil. Again there are disadvantages in another procedure we had tried—namely, the pressure flow of the finely divided gases up through tall columns of oil (for contact purposes) as is carried out in fat hydrogenation. In such a method one realizes at once the impossibility of maintaining the finely divided gas bubbles in this condition as they rise to the top of the oil column. Good contact then becomes poor. We did not pursue this feature further.

We were concerned mainly in apparatus using low power consumption. Next we used a reverse procedure as a new trial. Instead of dispersing the gas through the oil we distributed the oil in the gas chamber by means of a stirring device. (See Figure 4.) Apparatus such as this had been employed in other industries. In this manner, too, we could carry out the benzine synthesis. A disadvantage was the strong clouding and some foaming tendencies.

We next employed a counter-current idea—namely, to pass the oil by gravity down over packing in a tower, against the upward current of gases. The oil was recirculated. (See Figure 5.)

It developed that the space-time yields were quite poor, and the catalyst contained in the oil tended to deposit itself on the packing. Later we filled a rotating horizontal autoclave or chamber with packing. This apparatus has been used in other industries.[10] Here also the yields were poor. Apparently none of these contacters were as efficient as our first-developed apparatus with intensive stirring.

We next tried to add surface-active agents to the oil in order to increase the foaming tendencies of the oil. We found in peanut oil and in sodium soaps foaming tendencies when these were added to paraffinic oils in even minute quantities. In the presence of water-gas catalysts these surface-active agents soon

lost their strength and we finally obtained diminished yields of synthesis products.

Up to this point our experiences in working with oil-suspended catalyst can be summarized as follows:

Fundamentally, one can say, the water-gas reaction

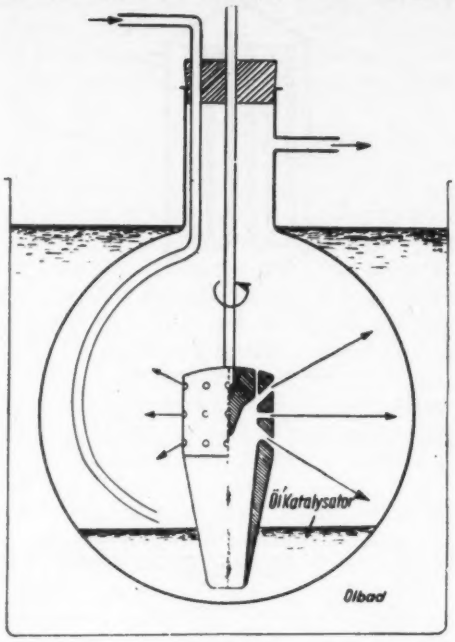

FIGURE 4
Dispersing oil and catalyst in gas space

takes place under a variety of mechanical conditions—when using the suspended catalyst idea. A great advantage is the good control of temperature rises, since overheating of the oil is not apt to take place readily. Important to remember, nevertheless, is that the speed of reaction is dependent on the fineness of dispersion of the gas in the oil. To comply with this

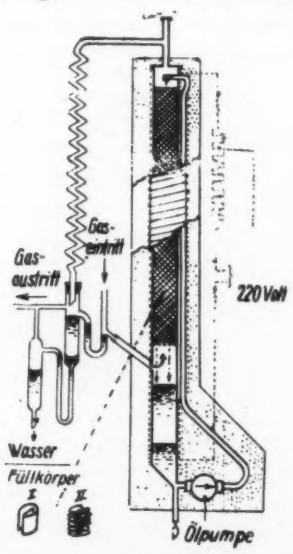

FIGURE 5
Recirculating oil and catalyst over packing

physical necessity one is compelled to either employ large amounts of the oil-catalyst mixtures, or to use the fine dispersion of the gas which necessitates a large power consumption.

It is well known that the catalytic reduction of carbon monoxide under pressure will not yield hydrocarbons but leads to aldehyde, acids and methanol formation.[11] We found it desirable next to investigate if this is also true when using the oil-suspended catalyst. We employed a nickel catalyst in connection with a stirring autoclave; 800 grams of reduced nickel-manganese-aluminum oxide contact suspended in 2600 cc.'s of hydrogenated oil. Using a 28/56 raw gas we found appreciable formation of oxygenated products when operating at 100-120° C. The product was very acidic and of pungent odor. The nickel catalyst, especially the nickel, left the autoclave in the form of nickel carbonyl, and in fact in such concentration (19.7 gms. per cubic meter) that upon separating the metal at 200° C. in glass tubes we were able to obtain pipes of the glistening metal. Tests along these lines concerning the reduction of carbon dioxide in contact with a fluid medium under pressure were continued later by F. Fischer and H. Kuster with cobalt catalysts, which do not form volatile carbonyls.

Tests With Dry Movable Catalyst

After these tests with stirred catalyst in which gas and catalyst are separated by the oil medium, we next developed the idea of using the moving catalyst in dry form. One of the ideas we had was that the heat of reaction could be more rapidly dissipated at the walls

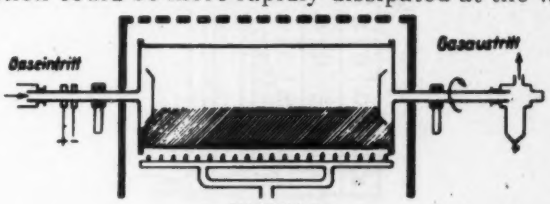

FIGURE 6
Revolving drum

of the vessel, and thereby reduce the rapid rises and temperature inequalities by the carrier-effect of the solid suspended catalyst, rather than using cooling-coils, etc. We carried out our tests in revolving drums heated externally with gas, and shown in Figure 6.

We also obtained good results in short drums—especially with a special arrangement for agitating the contact mass. For instance, one drum had the following specifications (operating conditions are also given):

Diameter	155 mm.
Length	450 mm.
R.P.M.	2
Gas	28/56
Gas Quantity	100 L/hour
Catalyst	890 grams Ni-Mn on Kieselgur
Temperature	195° C.
Contraction	60%
Yields	80 cc. or 56 grams of liquid per cubic meter.

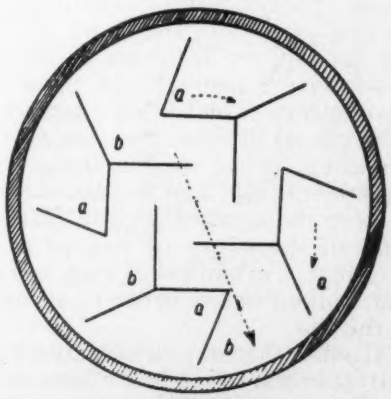

FIGURE 7
Insert for revolving drum, showing how contents of chamber revolve completely as in a or pass completely as in b.

Figure 7 shows the insert for the drum.

Yields changed, however, as soon as we over-

stepped some of the dimensions to larger dimensions. For instance, with a revolving drum 2 meters long, large temperature differences were difficult to control. Especially disadvantageous was the loss of catalyst as dust, which was quite appreciable due to the sweeping action of correspondingly large gas-volumes which had to be employed. It was not of value therefore to design larger drums.

Tests With Circulating Oil as Heating Element

Toward the end of the past year we centered on the idea of using oil as a heating medium circulating in spaces around the catalyst but not in contact with it. The simplest engineering element for such a purpose is a pipe. There are two alternatives here: the catalyst is placed in the pipe with the oil flowing around the pipe, or vice-versa. In our first trials we chose the second alternative since this arrangement affords a more efficient utilization of space.

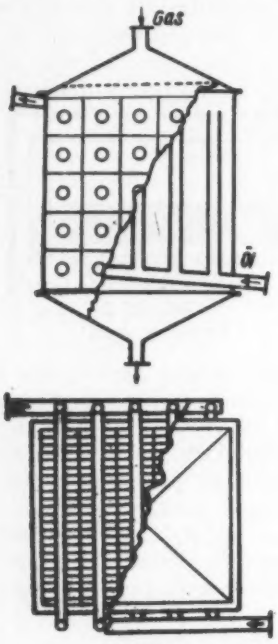

FIGURE 8
Radiator sections or ribbed contact chambers

We therefore built an apparatus consisting of ribbed or finned piping. It consisted of 25 horizontally placed seamless steel tubes (15-18 mm. diameter). Each pipe was fitted with ribs, square in shape (70 x 70 mm.), made of sheet metal about 1 mm. in thickness. These ribs were stretched and then securely welded onto the pipe at distances of about 13 mm. apart. The oil flowed through the pipes while the catalyst (again pieces of nickel, etc., catalyst) became lodged or was placed between the fins. See Figure 8.

As a circulating oil we used a cheap commercial high-boiling mineral oil. The results were that the fins did not keep the catalyst well in place, and that large amounts of sheet-iron are needed to cover the full stretch of pipe. Certain provisions, too, had to be included and worked out in order to secure A-1 distribution of the gas.

We next studied the other alternative: oil on the outside, catalyst in the tubes. We constructed a pipe-chamber, similar to vertical condensers, as shown in Figure 9.

In our earlier work using water under pressure as a heat-carrying medium, we could look ahead and found such a pipe vessel not feasible due to wall thicknesses being too large and also due to high pressures needed to prevent water evaporation or boiling. Oil presented a practical advance.

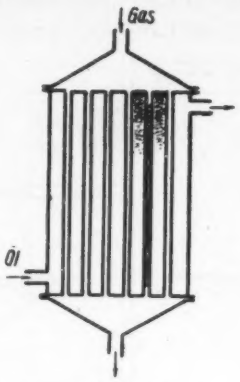

FIGURE 9
Tube and pipe chamber

The problem of length and diameter of pipe was next investigated and many tests were made. The

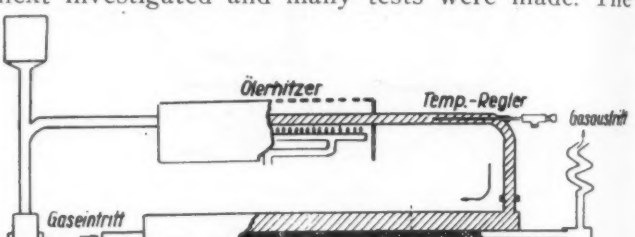

FIGURE 10
Arrangement to determine optimum tube diameters

apparatus is presented in Figure 10, and results tabulated in Figure 11.

It can be noted that 15-20 mm. appears to be the

	DIAMETER	ϕ in mm.	Surf. Area $cm^2/cc.$ vol.	Best Yield cc's./cu. m.	Temp. Control Yields Remarks
1		6	6.7	96	.....
2		15	2.7		very good
3		18	2.2		
4		19	2.1	135 to as low as 115	poor to bad
5		20	2.0		
6		21	1.9		
7		23	1.7	very low	
8		28	1.4	only methane	no bezine formation
9		18/39	1.3	very low	very bad
10		10/100	2.2	135	very good
11		15/100	1.5	111	poor

FIGURE 11
Effect of Pipe-Diameters.
Gas used is 28/56. (Length of catalyst layers: 0.3-5.0 m.)

optimum width for tubes; length of tube possibly somewhat over 5 meters or about 5 meters plus or minus. Such small-diameter tubing is of no advantage in building large-scale equipment, since this tubing is expensive, and difficult to fill and empty. We therefore tested out flat or oblong piping of rectangular cross-section. Optimum dimensions were: the catalyst layer could be as long as 5 meters, tube width at least 10 cm. but catalyst thickness not over 15 mm.

Summary of Results Thus Far

Our experience thus far is summarized as follows: Within the limits of dimensions as discussed, the apparatus and methods can be judged to be relatively simple, assuming constant and tireless attention be paid to strict temperature control at all points.

Excellent yields are then comparable to small-scale laboratory results. We will proceed on these principles at once since the temperature of the circulating oil is easily kept constant by electrical thermoregulators. A calculation showed also that the heat of reaction supplied to the oil supplies energy over and above that needed to furnish current for pumps and other equipment.

It seems large-scale construction was therefore in order; the contact layer thickness of course could not be increased; length of catalyst layer was also set at 5 m. while the width could be possibly increased.

At about that time Dr. Wenzel suggested contact-chambers, large in size and of a flat shape, connected in several batteries, and all immersed in a series of large oil-baths. We therefore constructed and tested out an apparatus something as follows:

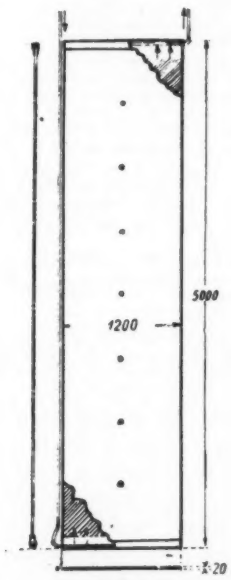

FIGURE 12
Contact chamber

Two sheet iron containers, of metal which is 4 mm. thick, 5 meters long, 1.5 meters wide were constructed by electrical welding. Dimension details are shown in Figures 12, 13, and 14.

The solid material to be added, namely the contact-mass, weighed 21.3 Kgm. of pieces of Ni-Mn-Al catalyst, previously described—and is used with approximately a gas flow of 6.8 cubic meters per hour.

In order to reduce the catalyst, the contact chamber was heated with recirculated air to 450° C., while simultaneously allowing hydrogen (saturated with ammonia gas) to stream through. Conversion then followed using "mixed gas" 24/48 at 190-210° C. With the gas we obtained 100 cc. (70 gm.) of fluid products per cubic meter—equal in yield to our laboratory results.

After 1000 hours operation regeneration had to follow as in the small-scale apparatus; the decline in

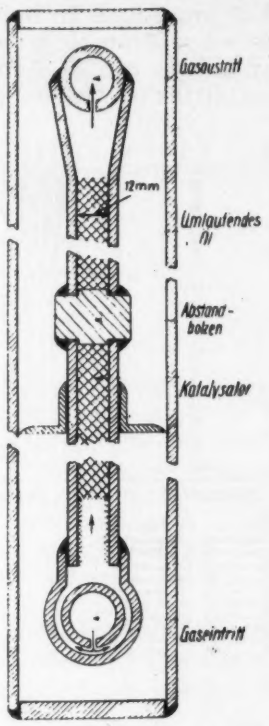

FIGURE 13
Side view through cell and oil bath

yield after 1000 hours is due of course to loss in catalytic activity, with losses also of large quantities of paraffins leaving with the exit gases. The paraffin wax saturating the catalyst was washed out with benzine and recovered by distilling off the benzine.

We were able to operate this apparatus quite automatically during the first 200 hours with ordinary care. Therefore for the remaining 800 hours we could

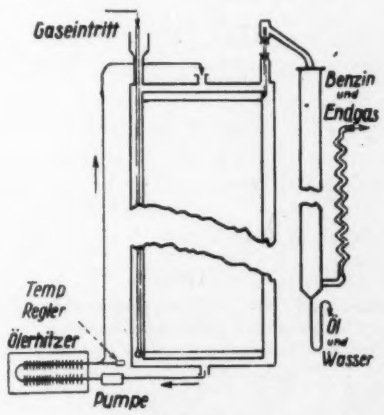

FIGURE 14
Test apparatus

continue then without interruption, giving some attention to gas-analyses, temperature control, etc., and stopping eventually as soon as the catalyst showed need for regeneration. There was no loss in time between these operations. The cycle of operation, etc., continued at night without attention whatever. The first few hundred hours of operation had

already shown that the benzene synthesis could be carried out quite feasibly with yields similar to small scale apparatus.

Further Development

We believe we have now, after many trials, found a useful method of procedure. In building our large commercial units we will proceed so that the individual contact chambers can be hung next to one another in large oil baths or vats, so as to form units

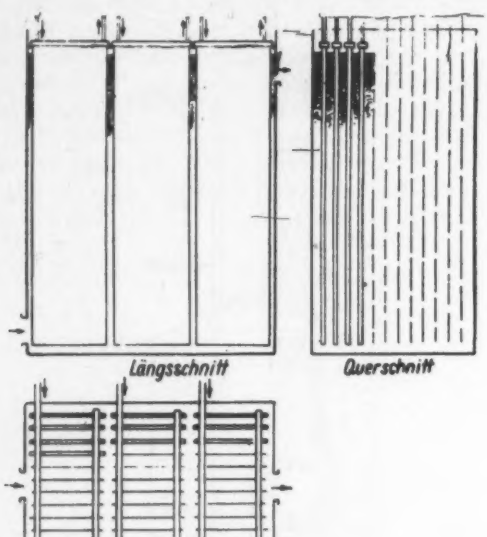

FIGURE 15
Scheme of a battery of cells

or batteries. Figure 15 gives the scheme as we visualize it at the present stage of development.

Such a close formation in batteries has many advantages. The chambers are large enough so that no surprises were to be expected, and we found later no need for changing the dimensions of such units. Damage to a single chamber is easily remedied by disconnecting the chamber from the remainder of the battery.

For the reduction stage, the chambers or cells can be collectively raised by a crane, withdrawn from the oil bath and brought to the desired reducing temperature in a special chamber or vat. The circulating oil removes absorbed heat of reaction and is cooled, while yielding its Btu contents to water or steam superheaters for available energy-supply heaters. This absorbed heat furnishes energy for the steam plant to the whole plant and many other uses, and is then far in excess of what is needed.

The simple construction details compared with our earlier apparatus and methods is of great advantage in estimating initial costs, such as labor, erection, etc. The practical aspects become excellent for large-scale erection of plants built on these outlines or principles.

Final opinion or details of large-scale results are of course pending, as are yields that are obtainable in commercial practice, since we are planning next to build a commercial unit, and operational details must first be worked out. Such operations will be based on our experiences described in this paper. The present results indicate more work is needed to develop a few fine points and that these can be developed already on the new commercial apparatus now pending. By-product wax and gasoil will be handled at a later stage, once we are operating on full 24-hour scale. The conversion of gasoil to lubricants will then follow.

Our next contribution will describe the forthcoming continuous large-scale operations, yields, and type of products as obtained commercially.

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[7] Compare Footnote (1).

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Refinery Processes for War Products

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Bechtel-McCone-Parsons Corporation

Before the annual meeting of the California Natural Gasoline Association, Los Angeles, November 5, 1943

THE petroleum refining industry is doing an outstanding job of producing vitally needed products for this nation's war effort. Natural-gasoline manufacturers and refiners of crude oil have pooled their efforts to make the most efficient utilization of every barrel of raw material. It is the purpose of this paper to present a review of the roles that refinery processes are playing in the production of war products, with special emphasis on one of the most vitally needed commodities—100 octane aviation gasoline.

This paper must, of necessity, be brief to meet the time requirements for presentation, and be general in nature so as to cover the refinery processes of major importance without revealing material which is classified as restricted by the United States Patent Office Secrecy Orders.

At the present time natural gasoline plus L.P.G. is being produced in California at the rate of some 46,000 barrels per day, refining crude at the rate of 665,000 barrels per day, and heavy crude at the rate of 115,000 barrels per day. Natural gasoline is normally produced with an end point of 300-325° F. Refining crudes contain materials boiling within the natural-gasoline range to the extent of 5 percent to 25 percent, depending on the type of crude. Assuming an average content of 12 percent of this material in the refining crude, we see that some 80,000 barrels per day, or over 60 percent of the total California production of straight-run fractions falling within the natural-gasoline boiling range, are produced at the refinery crude stills. Additional large volumes of these and similar fractions are also produced by cracking. Dr. A. H. Boultbee of Shell Oil Company, in a preceding paper*, has discussed the general processing of such fractions from the natural-gasoline viewpoint. Our paper will largely focus on the processing of these and higher-boiling fractions from the crude viewpoint.

Basis for Process Discussion

California war-time refining operations have been markedly influenced by aviation-gasoline demand. Since aviation-gasoline production is closely allied with natural-gasoline operations, our process review will focus primarily on its production. To facilitate the presentation, we will follow the handling of 10,000 barrels of a selected 31° API California crude through three stages of processing, extending from conventional pre-war operations to latest catalytic-cracking operations for high yield production of aviation gasoline.

Table 1 shows a straight-run distillation breakup of the selected crude into propane and lighter fractions, light straight-run gasoline, heavy straight-run naphtha, gasoil, and residuum. Typical percentage yields and characteristics of the distillate fractions as they influence aviation-gasoline production are given.

Conventional Pre-War Processing of Crude Oil Fractions

In the conventional pre-war processing of crude oil for primary products, (i.e. motor gasoline, stove oil, distillate fuels, and residual fuels) with only a small amount of aviation gasoline production, the following operations were adequate to meet product yield and quality requirements:

Crude fractionation
Thermal reforming
Thermal gasoil cracking
Thermal viscosity breaking

A brief review of these older processes appears in order, since they still have a definite place in war-time operations.

A simplified flow diagram of a crude oil distillation unit is shown in Figure 1. In this unit, crude oil is processed and fractionated in conventional distillation equipment to produce light straight-run gasoline, heavy naphtha, gasoil, and heavy residuum cuts of the character outlined in Table 1. The light straight-run gasoline would be stabilized in a conventional unit as illustrated, and then used for either motor- or aviation-gasoline blending.

Figure 2 presents a simplified flow diagram of a

TABLE 1

Typical Breakup of a Selected 31° API California Crude for Aviation-Gasoline Production

FRACTION	Reid V. P. Lbs./ Sq. In.	Octane CFR-M Clear	Vol. % Basis "0" Loss
C_3 and Lighter	....	....	0.35
Iso-Butane	77	99	0.20
Normal Butane	52	92	0.70
Iso-Pentane	21	90	0.60
Normal Pentane	15.5	61	0.75
C_6—250° Light S. R. Gasoline	5.5	72	5.40
225—450° Heavy S. R. Naphtha	1.5	55	24.00
Total Gasoline and Naphtha Fractions	....	....	31.65
450°-700° Gasoil—41 SSU @ 100 °F	....	....	32.0
700° Initial Resid.—100 SSF @ 210 °F	....	....	36.0

*"The Use of Natural Gas Components in Refinery Operations."

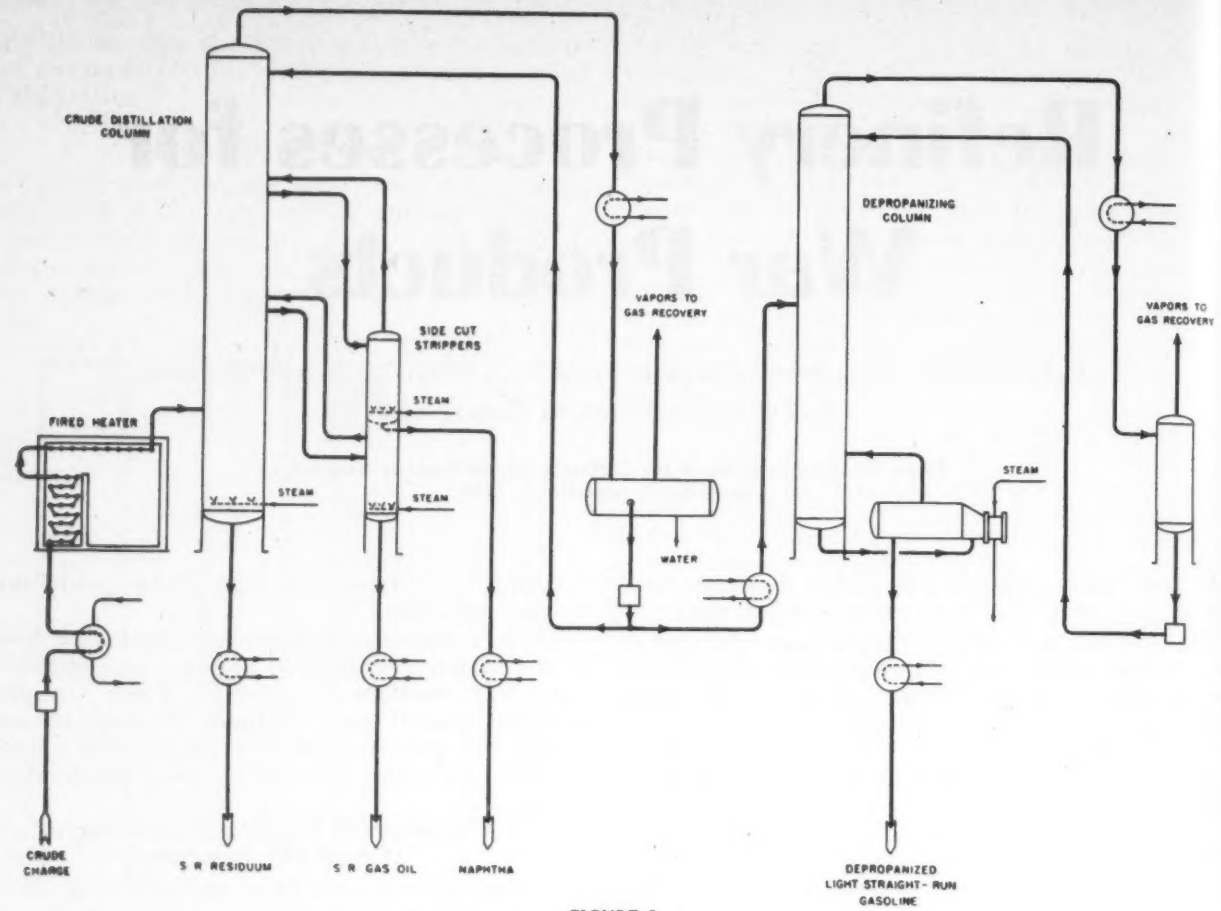


FIGURE 1
Crude Distillation

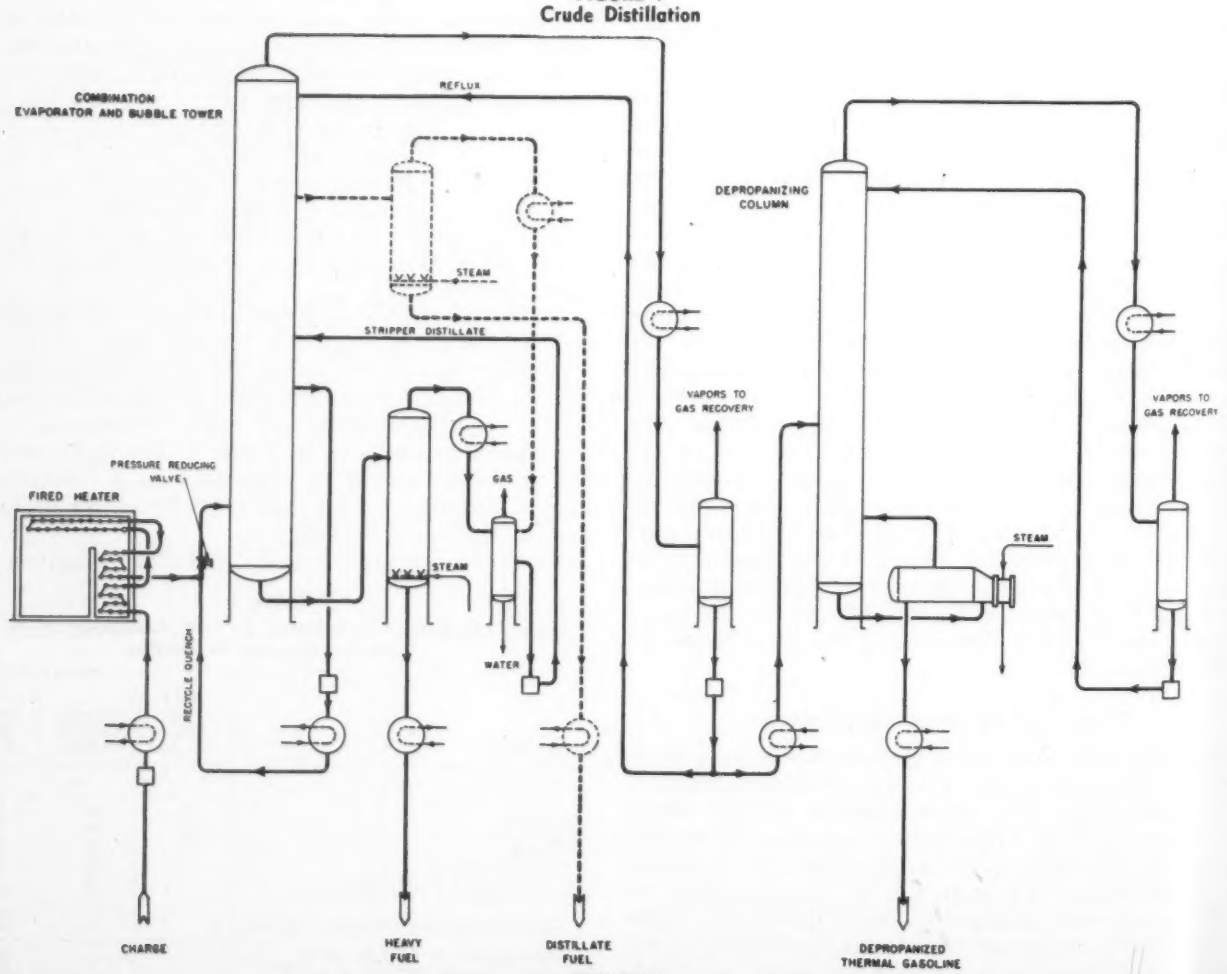


FIGURE 2
Once Through Thermal Reforming or Cracking

typical once-through thermal reforming or cracking unit. In this operation materials such as straight-run naphtha are subjected to cracking temperatures and pressures to produce higher-octane cracked gasoline, gas, tar and coke. While the flow of materials through the unit is evident from the flow sheet, it may be noted that the feed charge is introduced directly into the coils of the heater, all cracking is effected in the heater coils, the high pressure carried on the heater coils is reduced ahead of the combination evaporator and bubble tower, and a recycle stream of gasoil is used to quench the products leaving the fired heater for the purpose of controlling coke accumulation at the pressure-reducing valve and in the transfer line to the evaporator.

A simplified flow diagram of a two-coil recycle thermal-cracking and vis-breaking unit is shown in Figure 3. In this operation, a combined stream of gasoil and residuum from the crude distillation unit is introduced into a combination evaporator and bubble tower for separation into heavy and light cracking-coil-charge streams. These streams are then treated in separate-fired heaters under their respective optimum controls. The cracked streams leaving the two-fired heaters are combined into a single stream for introduction into the base of the evaporator. The charge stream of the light cracking coil contains both virgin and cycle gasoil. The quantity of gasoil recycled to this coil can be varied to give greater or smaller overall thermal-cracked gasoline yields—thus providing flexibility for the process. As with the simple, once-through operation, recycle gasoil is used for quenching the high-temperature streams leaving the cracking coils.

As an alternate operation, the gasoil and residuum streams would be separated at the crude-distillation unit and cracked separately. In such a case, the flow sheets for the cracking and vis-breaking units would be roughly similar to that presented for the thermal cracker of Figure 2.

Figure 4 presents a simplified block-and-line flow diagram showing charge and product quantities for a typical pre-war refinery operation utilizing crude distillation, thermal reforming, thermal gasoil cracking, and residual viscosity breaking for the production of motor-gasoline fractions, distillate and residual-fuel fractions, and a relatively small amount of aviation gasoline. Basis for the quantities presented is a 10,000-barrel throughput of the selected 31° API California crude of the composition shown in Table 1. It will be noted that this operation produces only some 6.7 percent of 91-octane aviation gasoline, even though all usable straight-run material is diverted to aviation-gasoline production. All thermal butanes and pentanes, as well as the heavier thermal-cracked gasoline fractions, are used to impart desired vapor-pressure and knock-rating characteristics to motor gasoline.

In connection with the indicated yields and product quantities of this flow diagram, as well as others

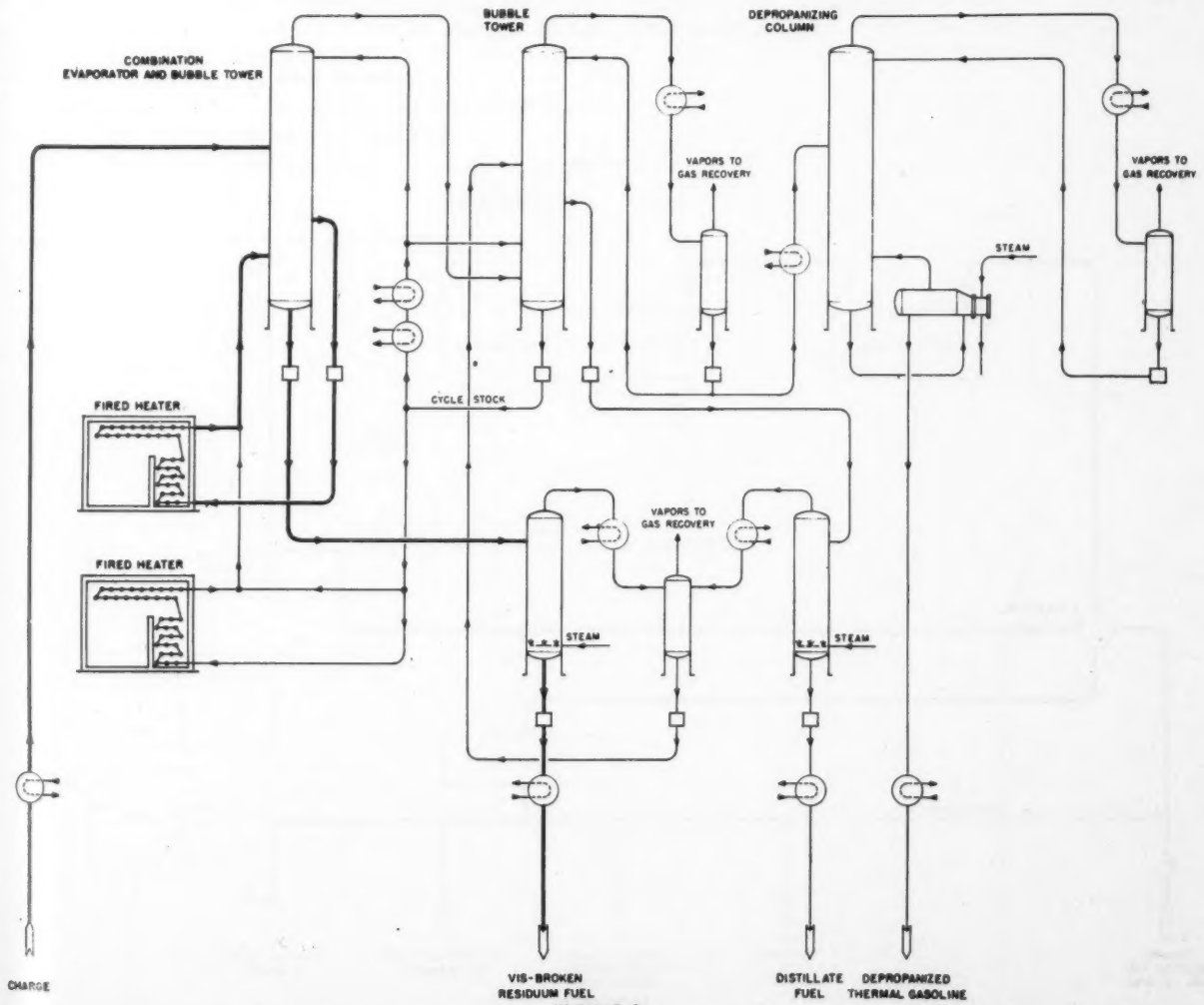


FIGURE 3
Two Coil Recycle Thermal Cracking and Vis-Breaking

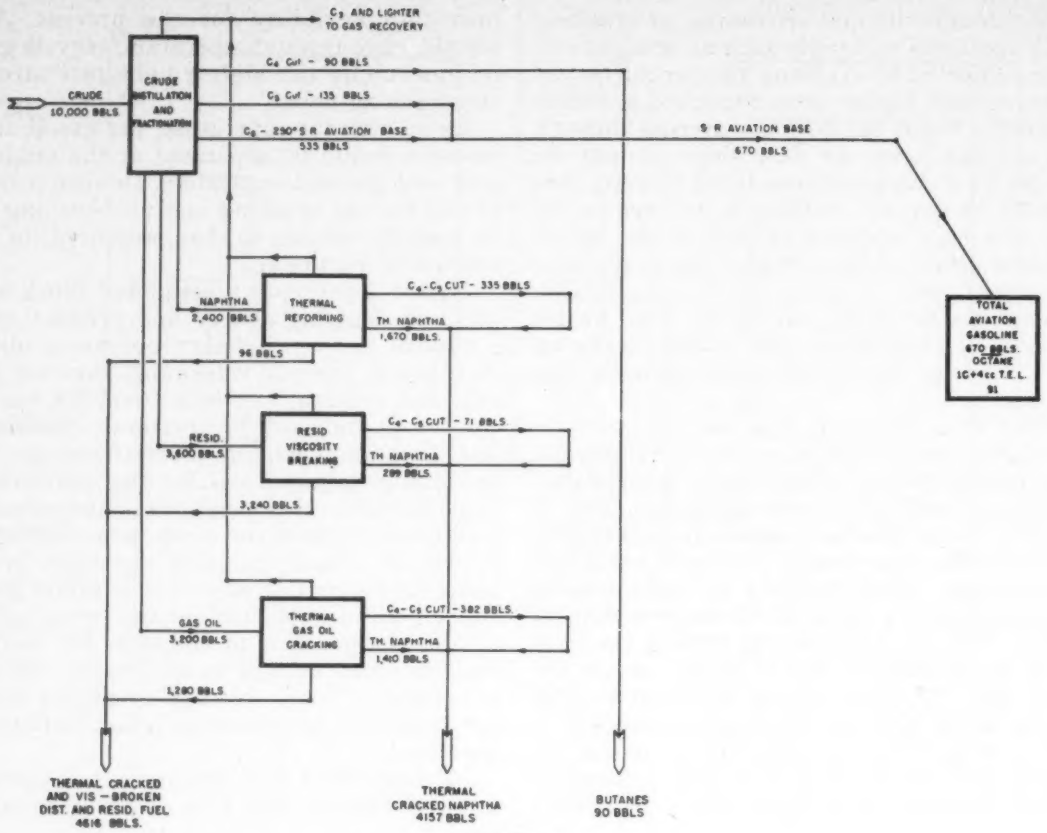

C3 AND LIGHTER TO GAS RECOVERY
CRUDE 10,000 BBLS
CRUDE DISTILLATION AND FRACTIONATION
C4 Cut - 90 BBLS
C5 Cut - 135 BBLS
C6 - 250°S R AVIATION BASE 535 BBLS
S R AVIATION BASE 670 BBLS
NAPHTHA 2,400 BBLS
THERMAL REFORMING
C4 - C5 CUT - 335 BBLS
TH. NAPHTHA 1,670 BBLS.
96 BBLS
RESID. 3,600 BBLS
RESID VISCOSITY BREAKING
C4 - C5 CUT - 71 BBLS.
TH. NAPHTHA 289 BBLS.
3,240 BBLS
GAS OIL 3,200 BBLS
THERMAL GAS OIL CRACKING
C4 - C5 CUT - 382 BBLS.
TH. NAPHTHA 1,410 BBLS.
1,280 BBLS
TOTAL AVIATION GASOLINE 670 BBLS. OCTANE 100+cc T.E.L. 91
THERMAL CRACKED AND VIS - BROKEN DIST. AND RESID. FUEL 4616 BBLS.
THERMAL CRACKED NAPHTHA 4157 BBLS
BUTANES 90 BBLS

FIGURE 4
Production of Aviation Gasoline from 10,000 Barrels, Selected 31° API California Crude, Thermal Cracking Only

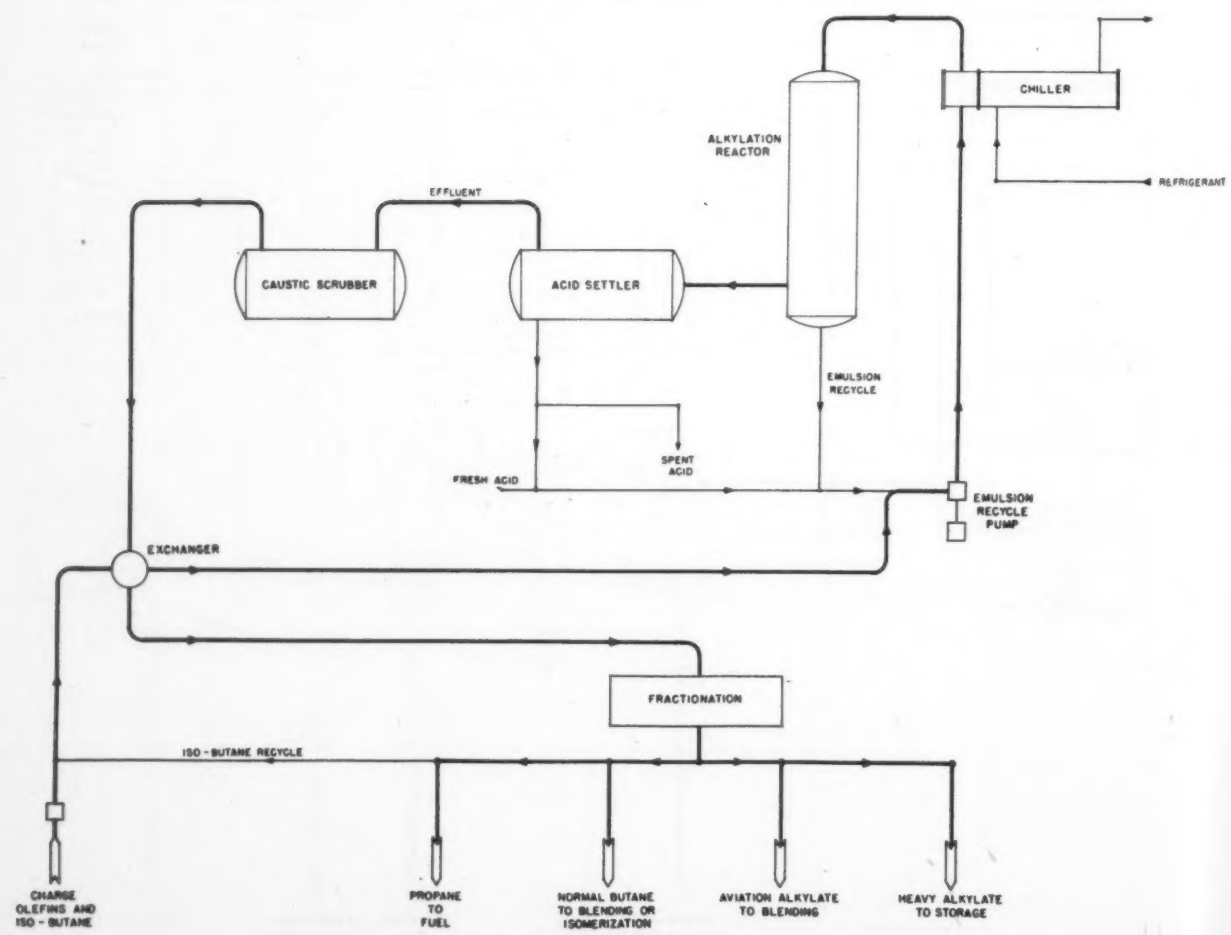


FIGURE 5
Sulphur Acid Alkylation Process

to follow, it would be understood that all secondary-production quantities and losses have been ignored in order to simplify the overall process comparison.

War-Time Processing of Crude Oil Fractions With Thermal Cracking

As noted above, the conventional pre-war refinery equipped for early peace-time operations was provided with crude-fractionating and thermal-cracking facilities only. As the demand developed for larger quantities of aviation gasoline of higher quality than could be produced from straight-run fractions alone, installation of modernized refining equipment was stimulated. The most important items of this modern equipment are alkylation, isomerization, and catalytic-cracking units.

Figure 5 presents a simplified flow diagram of a sulfuric-acid alkylation unit. In such a unit, propylenes, butylenes, and amylenes are combined with isobutane in the presence of a liquid catalyst (sulfuric or hydrofluoric acid) to produce a high quality aviation gasoline blending agent of relatively low vapor pressure. Feed stocks for such units consist of a mixture of olefins and isobutane with some normal paraffins. Isobutane is recycled through the unit along with the incoming feed stock for the purpose of maintaining high ratios of isobutane to olefins in the reaction zone so that polymerization of the olefin portion of the feed may be kept to a minimum. The reaction takes place in the liquid phase. A large emulsion recycle stream is circulated through a chiller in series with the alkylation reactor for control of reactor temperature. Extensive fractionating equipment is employed in connection with the alkylation plant to effect separation of propane, isobutane, normal butane, and pentanes from the effluent stream, and to segregate the alkylate production into aviation alkylate and heavy alkylate bottoms. Alkylate yields are of the order of 1.5-1.7 times the olefin feed, with isobutane requirements amounting to 0.95-1.25 times the olefin feed.

Figure 6 presents a simplified flow diagram of an isomerization unit. As the demand for volume production of aviation gasoline increased, it was often found that the supply of olefins from thermal-cracking units exceeded the supply of isobutane available for alkylation-plant feed. The isomerization process satisfies this deficiency by the conversion of normal butane to isobutane.

Butane-isomerization processes operate in either the vapor or liquid phase, according to the requirements of the process in question. Aluminum chloride is the basic catalyst used in all cases. The aluminum chloride may be sublimed and deposited on a solid carrier, or handled as a liquid by forming an aluminum chloride complex or mixture with other materials. In all cases, hydrogen chloride is used as an activator for the catalytic action, requiring facilities for thoroughly drying the incoming feed stream in order to avoid hydrochloric acid corrosion of the equipment. Isobutane yields of the order of 40-50 percent per pass are obtained, with total conversion yields amounting to over 98 percent of the net butane charge.

The isomerization process can also be adapted to pentane and hexane isomerization for the direct production of aviation-gasoline blending agents.

Figure 7 presents a block-and-line flow diagram of

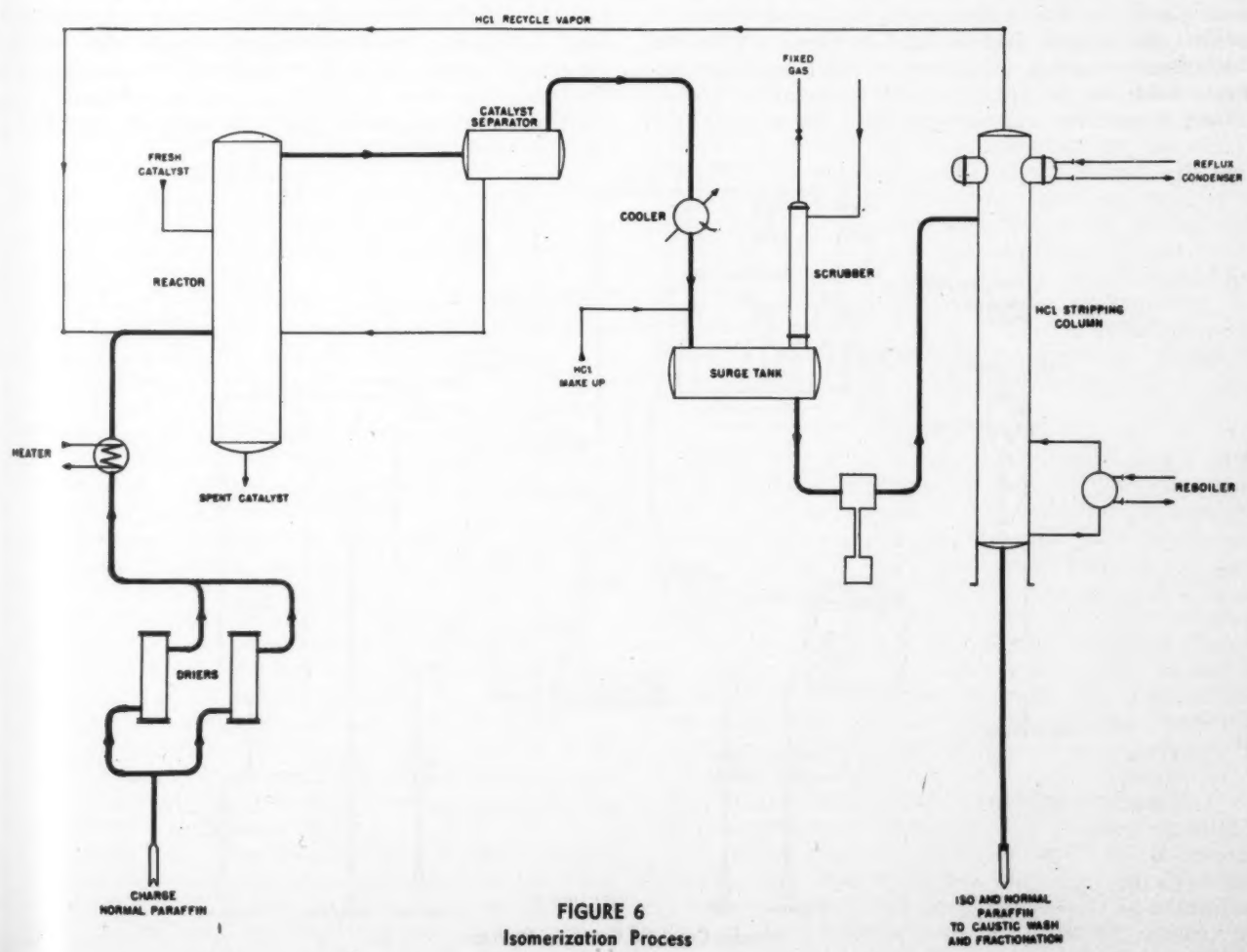


FIGURE 6
Isomerization Process

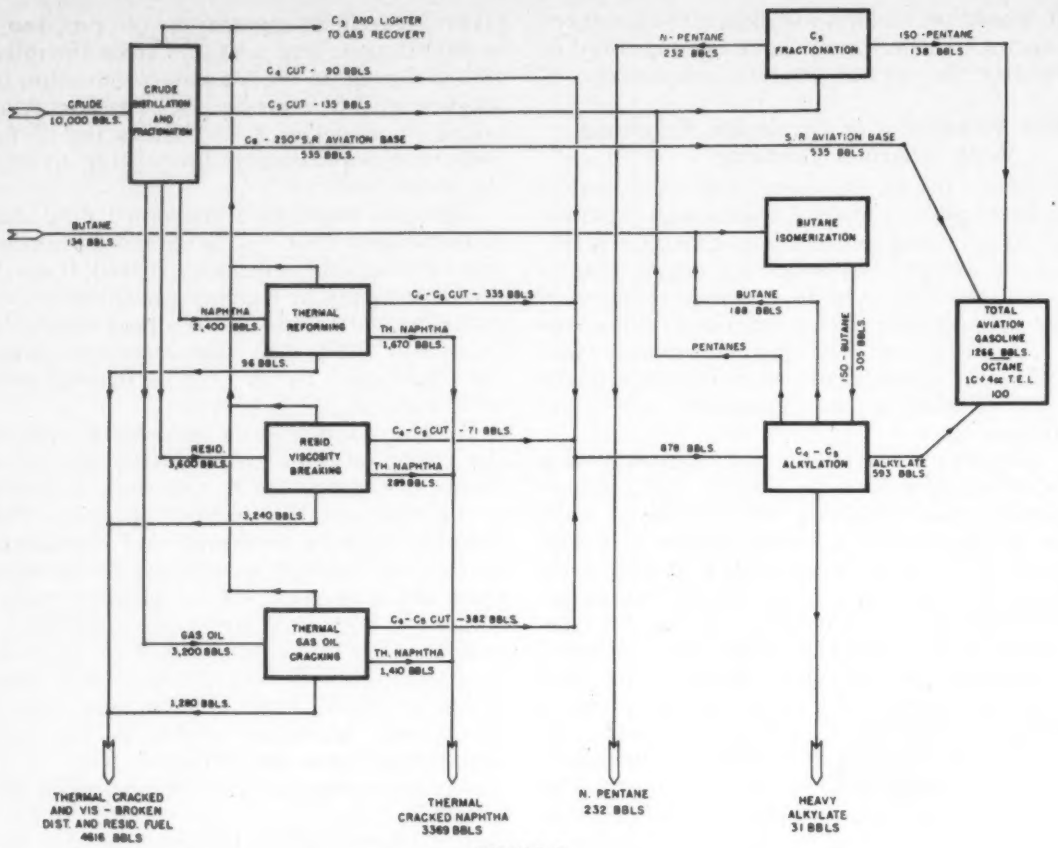

C3 AND LIGHTER TO GAS RECOVERY
CRUDE 10,000 BBLS.
CRUDE DISTILLATION AND FRACTIONATION
C4 CUT - 90 BBLS.
C5 CUT - 135 BBLS.
C6 - 250°S.R AVIATION BASE 535 BBLS.
BUTANE 134 BBLS.
NAPHTHA 2,400 BBLS.
THERMAL REFORMING
C4 - C8 CUT - 335 BBLS.
TH. NAPHTHA 1,670 BBLS.
96 BBLS.
RESID. 3,600 BBLS.
RESID. VISCOSITY BREAKING
C4 - C8 CUT - 71 BBLS.
TH. NAPHTHA 209 BBLS.
3,240 BBLS.
GAS OIL 3,200 BBLS.
THERMAL GAS OIL CRACKING
C4 - C8 CUT - 382 BBLS.
TH. NAPHTHA 1,410 BBLS.
1,280 BBLS.
THERMAL CRACKED AND VIS - BROKEN DIST. AND RESID. FUEL 4616 BBLS.
THERMAL CRACKED NAPHTHA 3369 BBLS.
N. PENTANE 232 BBLS.
HEAVY ALKYLATE 318 BBLS.
N - PENTANE 232 BBLS.
C5 FRACTIONATION
ISO - PENTANE 138 BBLS.
S. R AVIATION BASE 535 BBLS.
BUTANE ISOMERIZATION
BUTANE 188 BBLS.
PENTANES
ISO - BUTANE 305 BBLS.
878 BBLS.
C4 - C8 ALKYLATION
ALKYLATE 593 BBLS.
TOTAL AVIATION GASOLINE 1266 BBLS. OCTANE 1C+4cc T.E.L. 100

FIGURE 7

Production of Aviation Gasoline from 10,000 Barrels, Selected 31° API California, Thermal Cracking Plus Alkylation and Butane Isomerization

the original pre-war refinery operation of Figure 4, modified to include butene and pentene alkylation, butane isomerization, and pentane fractionating operations. Addition of alkylate and removal of normal pentane from the aviation-gasoline blend makes it possible to readily produce 100-octane material; olefins, isobutane, and isopentane from the thermal cracking units formerly used for motor-gasoline blending are now diverted to aviation-gasoline production; and the total yield of aviation gasoline is

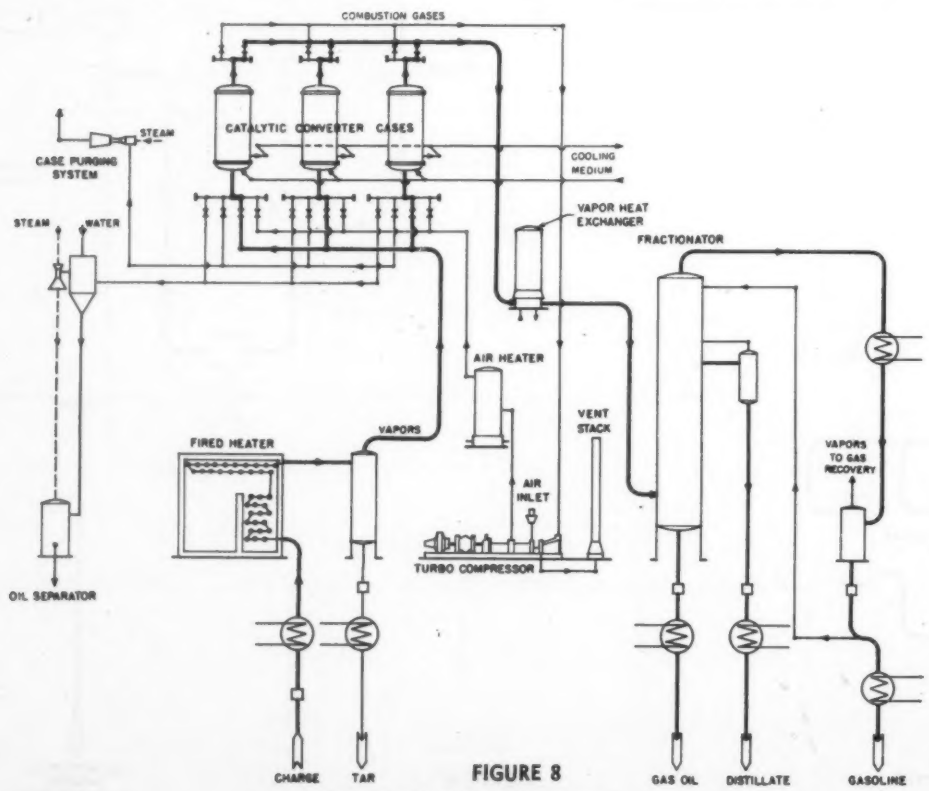


FIGURE 8

Houdry Catalytic Cracking Process

substantially increased—amounting to some 12.7 percent of 100-octane gasoline as compared with the original 6.7 percent production of 91-octane materials. In order to achieve this yield, however, the plant-produced butane feed stock for butane isomerization had to be augmented by some 134 barrels from an outside source.

Though the thermally-cracked gasoline contains a large amount of material boiling within the aviation-gasoline range, none of this material can be included in the aviation-gasoline blend due to its high olefin content. As a consequence, increasing the aviation-gasoline production beyond that characterized by the operations of Figure 7 requires the use of a cracking operation which will produce high yields of aromatics and isoparaffins in place of the high olefin yields of the thermal-cracking units. This need is met by catalytic cracking.

Catalytic Cracking Processes

In contrast to the relatively simple process flows of the older thermal cracking units, the process requirements of catalytic-cracking cycles appear rather complex. This is due to the fact that coke resulting from the cracking reaction deposits on the catalyst, and must be removed by burning in order to maintain catalyst activity. Methods of heat control, heat recovery, and catalyst handling employed in the regeneration of the catalyst constitute the distinguishing mechanical differences in today's commercial catalytic-cracking process.

While differing in methods employed for catalyst handling and regeneration, and in the specific catalyst used, the three commercial catalytic-cracking processes in use today; namely, Houdry, Fluid, and Thermofor Catalytic Cracking (TCC) have the following process features in common:

1. All use solid catalysts of the contact or adsorptive type.
2. The catalysts are chiefly natural and chemically treated clays, or synthetic materials of the same general composition.
3. The cracking reaction is effected wholly in the vapor phase in the presence of the catalyst at low pressures of the order of 10 to 50 pounds per square inch, gauge.
4. Cracking temperatures of the order of 800-1000° F., and maximum regeneration temperatures of the order of 1100-1200° F., are employed.
5. A circulating cooling system is used to control the temperature of the catalyst during regeneration, and to remove and recover waste heat.
6. The catalyst slowly loses its efficiency in operation and must be periodically or continuously replaced with fresh material.
7. The depth and character of cracking is primarily governed by the specific type of catalyst employed, degree of catalyst activity, catalyst to oil ratio, time of contact, and cracking temperature.

Catalytic processes employing solid catalysts may be broadly divided into two classifications according to the method employed for handling the catalyst:

1. Static Bed Processes, in which the catalyst remains static in the reactor case during both cracking and regeneration, and in which the case is alternately shifted from one operation to the other by appropriate valving.
2. Moving Bed Processes, in which the catalyst continually circulates through separate cracking and regeneration zones with continuous flows of oil vapors and regenerating air being maintained through the respective reactor and regenerating sections.

The Houdry process belongs to the first class, and the Fluid and TCC processes to the second class.

Houdry Process

Figure 8 presents a simplified flow diagram of the Houdry process. In this process, a number of static bed catalyst cases are manifolded together and so operated that one or more cases are always on stream for cracking service while others are being purged and regenerated. The essential elements of the process consist of:

1. Conventional fired heaters and separators for supplying a vaporized feed to the catalyst cases.
2. A plurality of catalyst cases—usually three or more units.
3. An automatically timed valving system for synchronously shifting case services.
4. Purging facilities for removing oil vapors and combustion gases from the cases.
5. A heated air supply for catalyst regeneration.
6. A molten salt circulating system for control of reaction temperatures and removal and recovery of excess heat.
7. Turbo generators for waste-heat recovery.
8. Conventional fractionating equipment for separating the cracked materials into appropriate cuts.

The catalyst employed in the Houdry process is usually in the form of pellets approximately 1/6-inch in diameter and length. Finned tubes are distributed through the catalyst bed to accommodate the circulating salt system. This system serves the threefold purpose of removing excess heat during the regenerating period, adding heat during the on-stream cracking period, and recovering waste heat through interchange with feed stock and/or generation of stream. Each case in turn is held on stream for a definite period of time set by the amount of coke which can be allowed to accumulate on the catalyst without too adversely affecting catalyst efficiency. During this period the other cases are purged and regenerated. Cases are synchronously shifted from service to service by an automatically timed valving system, thus assuring continuity of oil vapor flow. Regeneration air is supplied at a pressure of 45-50 pounds gauge. Heat energy is recovered from the resultant high-temperature-combustion gases by using them to drive a turbo generator.

Fluid Process

Figure 9 presents a simplified flow diagram of the Fluid catalytic cracking process. In contrast to the multiple service cases of the Houdry process, this system employs separate reactor and regenerator units. Catalyst in finely powdered form is circulated continuously through first the reactor and then the regenerator zones by vapor and air-stream action. A continuous flow of oil vapors is maintained through the reactor zone, and a continuous flow of hot air for catalyst regeneration through the regeneration zone. Essential elements of the process consist of:

1. Conventional fired heaters and separators for supplying vaporized feed to the reactor.
2. Separate reactor and regenerator vessels.
3. Hoppers and standpipes for feeding circulating catalyst into the oil-vapor and hot-air streams.
4. Cyclone separators for removing catalyst from the oil-vapor and combustion gas streams leaving the reactor and regenerator zones, and

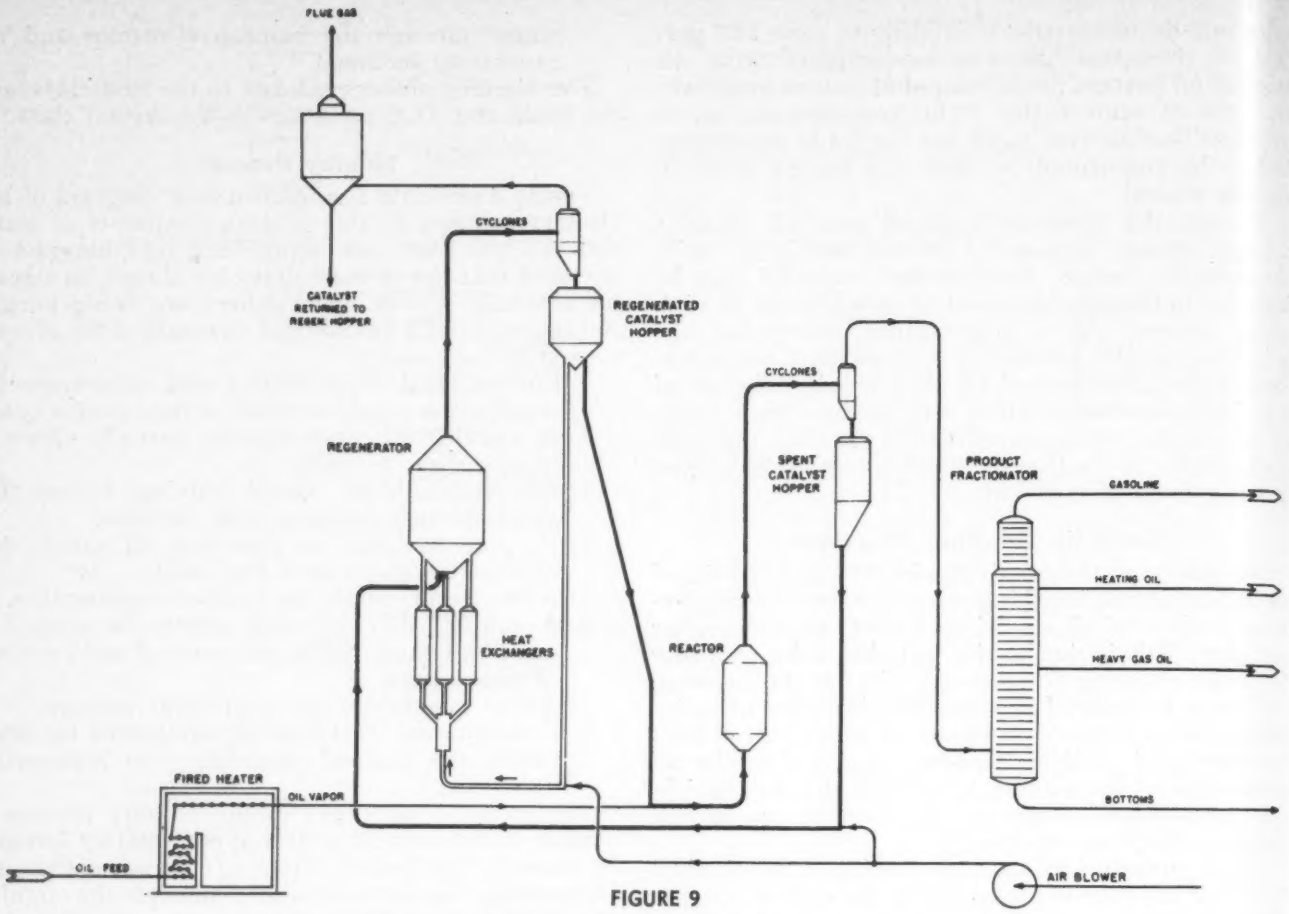


FIGURE 9

Fluid Catalytic Cracking Process

Cottrel precipitators for removing catalyst fines from the exit flue gases.

5. An air supply for catalyst regeneration.
6. A secondary air-actuated catalyst recirculating system for removing and recovering excess heat from the regenerating zone.
7. Conventional fractionating equipment for separating the cracked materials into desired cuts.

The catalyst used in the Fluid process is a fine powder, ranging in size from 300 mesh down to a few microns, and is of such a character that it can be handled similarly to a freely flowing fluid. The catalyst is introduced into the vapor and oil streams by the differential head built up by compacted catalyst in hopper standpipes, and then circulated through the heat exchangers, treaters, regenerators, dust separators, etc., by the kinetic energy of the flowing air and oil-vapor streams. Cyclone separators remove the catalyst from the exit vapor streams and return it to the feed hoppers for recirculation through the system. Temperature control at the regenerator is obtained by recirculation of regenerated catalyst through interchangers operated in series with the regenerator. Excess heat is removed by interchange with incoming feed stock and/or steam generation. Density of the catalyst-vapor system in the reactor can be varied to obtain desired catalyst-to-oil flow ratio. Rates of catalyst circulation through the reactor are set to meet process requirements. A uniform temperature is maintained throughout the treater vessel.

TCC Process

Figure 10 presents a simplified flow diagram of the TCC process. In contrast to the Fluid process, the TCC process uses a catalyst in the form of pellets or beads which are moved through separate reactor and regenerator units by gravity. Continuous flows of oil vapors and regeneration air are maintained through the reactor and regenerator units. Essential elements of the process consist of:

1. Conventional fired heaters and separators for supplying vaporized feed to the reactor case.
2. Separate reactor and regenerator units.
3. An elevated catalyst hopper, and a pair of catalyst elevators for maintaining flow of catalyst through the system.
4. Dust separators for removing catalyst fines from the exit combustion gas stream.
5. An air supply for catalyst regeneration.
6. A high-pressure water circulation and steam-generating system for control of catalyst regeneration temperature and recovery of waste heat.
7. A conventional fractionating system for separating the cracked products into desired cuts.

The TCC catalyst may be in the form of chemically-treated natural clay particles varying in size from 4 to 60 mesh synthetic pellets, or the new synthetic bead catalyst which is approximately ⅛-inch in diameter. Catalyst is introduced into the reactor by gravity head developed in a hopper and standpipe located above the reactor. Subsequent flow is downward by gravity through the reactor, up by elevator to the top of the regenerating kiln, down by gravity through the regenerator, and up by elevator to the catalyst hopper. Cyclone separators remove catalyst fines from the exit combustion gases. Temperature control in the kiln is obtained by direct generation of 400-500-pound steam in boiler tubes distributed through the kiln. Regeneration air is supplied at a number of points in the kiln, with resultant combustion gases

being removed from multiple take-offs adjacent the air inlets. Rates of catalyst circulation are set by process requirements.

The new synthetic bead catalyst used with the TCC process is extremely rugged. This ruggedness, combined with exceptional catalytic performance in the production of aviation gasolines, makes it extremely attractive for the mechanical circulation system of the TCC operation.

Catalytic Cracking for Aviation Gasoline Production

While details of operation and control vary considerably between the three catalytic cracking processes now in commercial operation, the following important generalizations can be made regarding the utilization of catalytic cracking and treating for the production of high quality aviation gasoline components.

1. Highest quality aviation gasolines are produced from naphthenic feed stocks, and lowest quality from paraffinic feed stocks.
2. Increasing the temperature and severity of cracking increases the yields of olefins and isobutane in the lower-aviation-gasoline-boiling range, and the yields of aromatics in the higher-boiling ranges.
3. High-aviation gasoline qualities and yields are obtained by second-pass treatment of a butane or pentane-free first-pass high end-point gasoline cut—with the treating conditions being more severe for the second-pass treating operation than the first-pass cracking operation.
4. The quality increase achieved by second-pass treatment is obtained through elimination of olefins from the lower-boiling fractions, and production of additional aromatics in the upper-boiling fractions.
5. In addition to producing high quality aviation base stock, two-pass catalytic cracking simultaneously yields substantial quantities of isobutane and olefins for alkylation. High yields of isopentane are also obtained—with this production often being larger than can be utilized in the 7-pound Reid catalytic aviation gasoline blend.
6. The heavier the charging stock from a given crude source, the higher the olefin yield.
7. Within limits, relative productions of isoparaffins and olefins can be varied by choice of catalyst used, and depths and severity of cracking employed.
8. The 7-pound Reid catalytic aviation gasoline will in general fall within the following quality ranges:

Octane Rating	
ASTM Clear	77—82
AFD—1C + 4 cc TEL	92—97
Acid Heat, °F.	10—25
Aromatic Content, Volume pct.	20—30

Superior qualities to above are obtainable from selected charging stocks, or by special processing schemes.

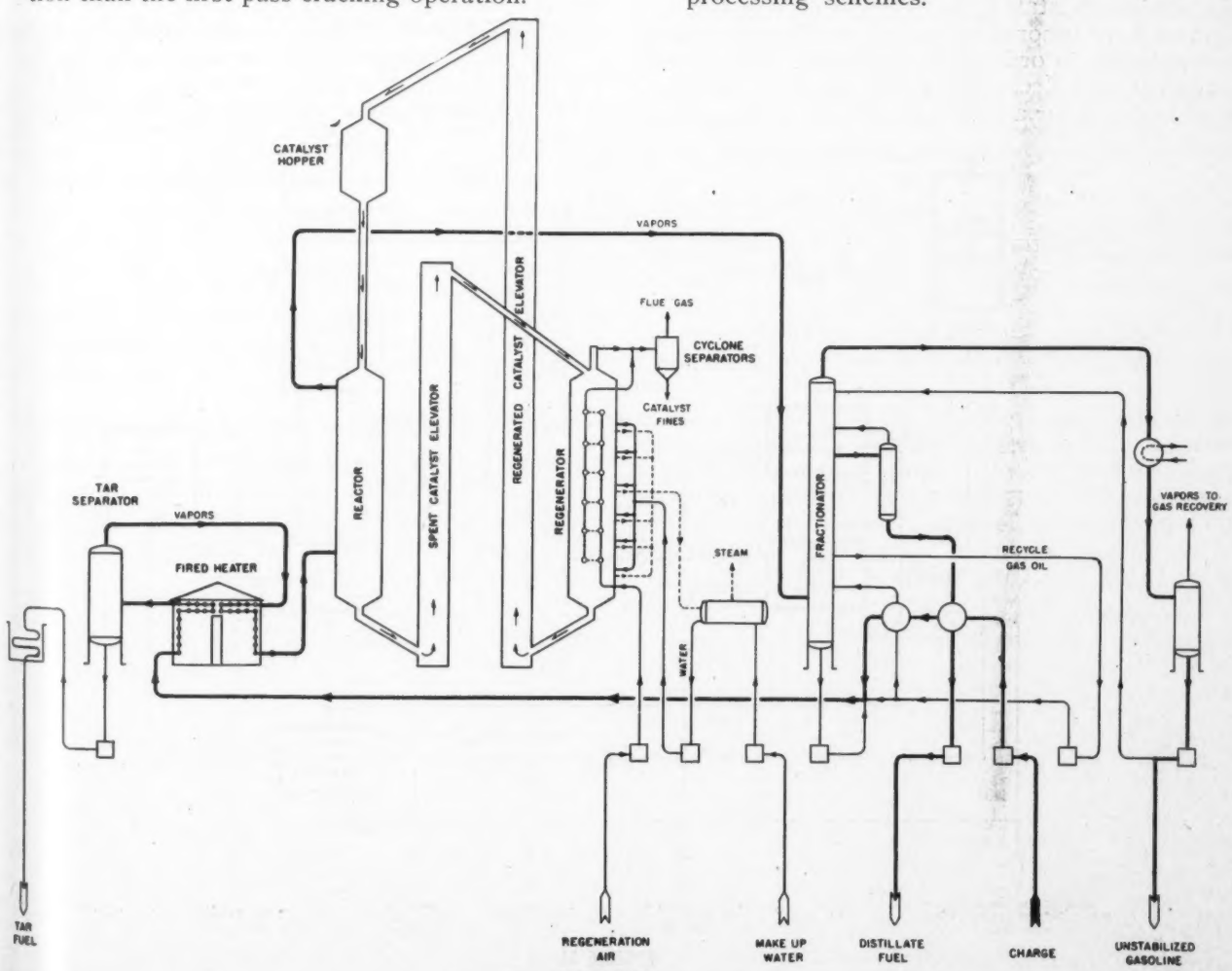


FIGURE 10

Thermofor Catalytic Cracking Process

War-time Processing of Crude Oil Fractions With Catalytic Cracking

Figure 11 presents a block-and-line flow diagram in which two-pass catalytic cracking of gasoil replaces the recycle thermal gasoil cracking of Figure 7. With this substitution the production of 100-octane aviation gasoline is again doubled, and a surplus of 436 barrels of isobutane is produced as compared with the 134-barrel butane deficit experienced with the thermal gasoil-cracking operation. These figures aptly illustrate the extreme adaptability of catalytic cracking to aviation-gasoline production. Not only does the catalytic process provide large yields of high quality base stock, but also high accompanying yields of isobutane and olefins for alkylation, and isopentane for direct aviation-gasoline blending.

Summarized Refinery Processing Operation

Table 2 presents a summary of the pertinent figures connected with the processing operations of Figures 4, 7, and 11, covering:

a. Conventional pre-war crude distillation and thermal cracking operations.
b. Conventional pre-war crude distillation and thermal cracking operations, augmented by pentane fractionation, butene-pentene alkylation and butane isomerization.
c. Conventional crude distillation and thermal operations modified as in (b) above, with catalytic gasoil cracking substituted for thermal gasoil cracking.

As previously stated, the yield figures of the flow diagrams have ignored secondary production quantities and losses in order to simplify the overall process comparison. Recognizing this point, reference to the table shows for a 10,000-barrel run of the particular crude chosen and particular processing operations used:

1. Addition of alkylation and isomerization operations to conventional pre-war crude distillation and thermal cracking operations doubles the aviation gasoline production, while raising the

TABLE 2
Production of Aviation Gasoline from 10,000 Barrels Selected 31° API California Crude

COMPONENTS	QUALITY		PRODUCTION—BBLS.		
	Reid V. P. Lbs./In²	Octane 1C + 4 cc.— T.E.L.	"A" Thermal Cracking	"B" "A" + Alk. + C_4 Isom.	"C" "B" + Cat. Cracking
Aviation Gasoline Components:					
C_5 Free Virgin Base Stock	3.5	90.0	535	535	535
C_5 Free Catalytic Cracked Base Stock	2.5	96.0	....	....	895
C_4 Alkylate	4.0	i+0.8	....	347	400
C_5 Alkylate	2.5	i+0.5	....	246	152
Iso-Pentane	20.6	i+1.5	60	138	436
Pentenes	15.5	74	....	....	[illegible]
Normal Pentane	15.5	87	75	....	32
Case "A"—Blended to 91 Octane	6.4	91	670	....	....
Case "B"—Blended to 100 Octane	5.2	100	....	1266	....
Case "C"—Blended to 100 Octane	6.1	100	....	....	2466
Normal Butane (Deficiency)	....	....	....	(134)	....
Iso-Butane Surplus	....	....	....	....	436
Total "Net" Aviation Component Yield	....	....	670	1132	2902
Remaining C_4—410° Gasoline Components:					
Iso-Butane	....	....	83	....	....
Butene	....	....	215	....	....
Normal Butane	....	....	188	....	....
Iso-Pentane	....	....	78	....	....
Pentenes	....	....	157	....	....
Normal Pentane	....	....	157	232	156
C_6—410° Thermal Cracked Naphtha	....	....	3369	3369	1959
Heavy Alkylate	....	....	....	31	29
Total Remaining C_4—410° Components	....	....	4247	3632	2144
Fueloil Components—Total	....	....	4616	4616	4296
Total "Net" C_3 Free Liquid Components	....	....	9533	9380	9342

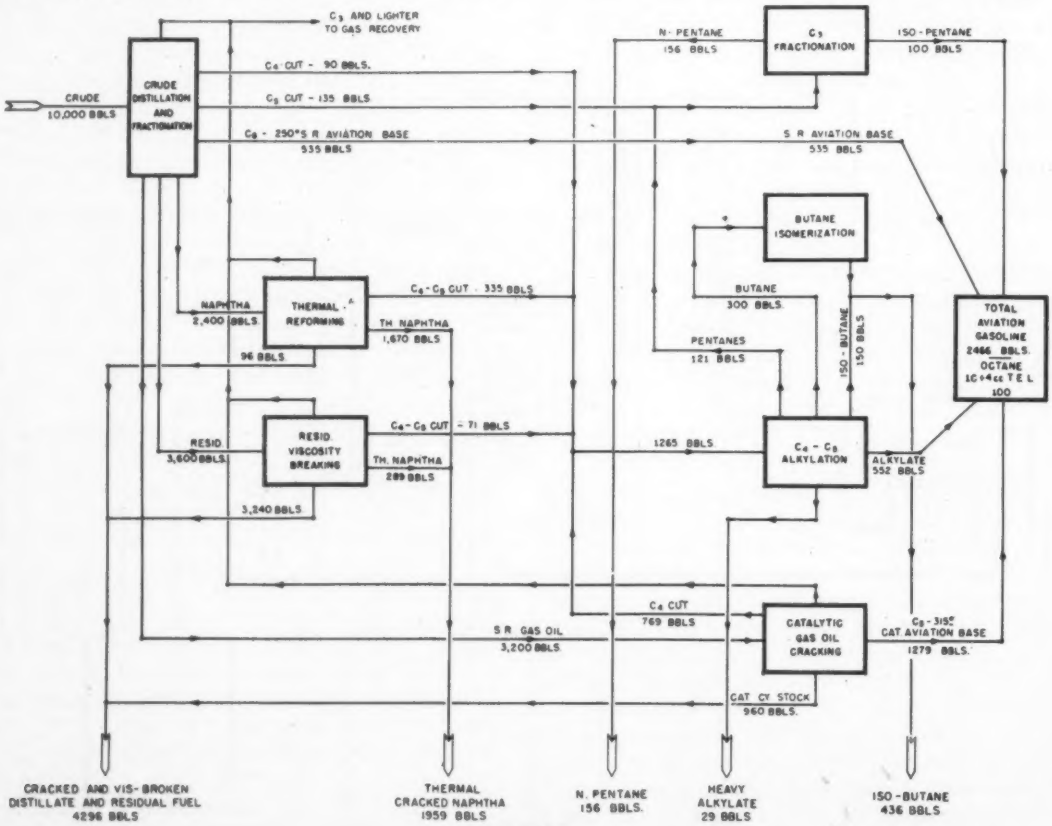

C3 AND LIGHTER TO GAS RECOVERY
CRUDE 10,000 BBLS
CRUDE DISTILLATION AND FRACTIONATION
C4 CUT - 90 BBLS.
C5 CUT - 135 BBLS
C6 - 250°S R AVIATION BASE 535 BBLS
N-PENTANE 156 BBLS
C5 FRACTIONATION
ISO-PENTANE 100 BBLS
S R AVIATION BASE 535 BBLS
BUTANE ISOMERIZATION
BUTANE 300 BBLS.
PENTANES 121 BBLS
ISO-BUTANE 150 BBLS
TOTAL AVIATION GASOLINE 2466 BBLS. OCTANE 1C+4cc T E L 100
NAPHTHA 2,400 BBLS
THERMAL REFORMING
C6-C9 CUT - 335 BBLS
TH. NAPHTHA 1,670 BBLS
96 BBLS
RESID 3,600 BBLS
RESID VISCOSITY BREAKING
C6-C9 CUT - 71 BBLS
TH. NAPHTHA 289 BBLS
3,240 BBLS
1265 BBLS
C4 - C5 ALKYLATION
ALKYLATE 552 BBLS
C4 CUT 769 BBLS
S R GAS OIL 3,200 BBLS
CATALYTIC GAS OIL CRACKING
C9-315° CAT AVIATION BASE 1279 BBLS.
CAT CY STOCK 960 BBLS.
CRACKED AND VIS-BROKEN DISTILLATE AND RESIDUAL FUEL 4296 BBLS
THERMAL CRACKED NAPHTHA 1959 BBLS
N. PENTANE 156 BBLS.
HEAVY ALKYLATE 29 BBLS
ISO-BUTANE 436 BBLS

FIGURE 11

Production of Aviation Gasoline from 10,000 Barrels, Selected 31° API California Crude, Cracking Plus Alkylation, Plus Butane Isomerization Plus Catalytic Cracking

gasoline octane rating (AFD—IC + 4 cc TEL) from 91 to 100.

2. In order to achieve this production, additional normal butane must be obtained from outside sources for isomerization-plant feed.
3. Substituting two-pass catalytic cracking for recycle thermal gasoil cracking again doubles the aviation-gasoline production.
4. With catalytic cracking, a surplus of 436 barrels of isobutane results as compared with a butane deficit of 134 barrels for thermal cracking.
5. Aviation-base-stock production from the catalytic-cracking operation is of considerably higher quality than the virgin base stock.
6. In going from the conventional pre-war operation to full-scale aviation-gasoline production, components remaining for motor-gasoline production are cut in half.
7. The percentage of C_4 and C_5 fractions available for motor-gasoline blending drops from some 23 percent of the total motor gasoline components in the case of conventional pre-war operations, to some 7 percent for the case of large-scale catalytic aviation-gasoline production.
8. A marked increase in aviation-gasoline production causes only a relatively small reduction in total distillate and residual fuel production.

It should be emphasized that the figures of Table 2 are illustrative only, and are in no way intended to present a completely balanced refining operation which would, of course, take into consideration secondary yields and losses, and account for properly treated and blended finished motor gasoline production. The schedule does show the general effect on availability and quality of other refining products of increased aviation-gasoline production, and the importance of catalytic cracking in the war-time aviation-gasoline program. Yields used are conservative. In many cases it would be possible to substantially increase the yield of 100-octane gasoline over that indicated by employing such additional operations as propylene alkylation, thermal re-cracking of catalytic cycle stock, pentane and hexane isomerization, etc.

Catalytic Cracking for Motor Gasoline Production

In a review of this character, it should not be amiss to pause for a minute to look into the future.

One of the outstanding characteristics of catalytic-cracking processes is their ability to produce high-quality motor fuels from a wide variety of charging stocks. This is shown in Table 3, which presents the results of catalytically cracking two widely different gasoils by two different processes for the production of some 46 percent of motor gasoline. These data are not presented for comparative purposes but to illustrate process yields and qualities.

TABLE 3

Motor Gasoline Production—Cracking of Light and Heavy Gasoils by Two Different Catalytic Processes

	Heavy Gasoil	Light Gasoil
Feeds:		
Gravity—°API	22.3	33.6
Aniline Point, °F	171	135
AST- 50% distn.—°F	825	485
Sulfur—Wt. %	2.49	0.46
Yields:		
Motor Gasoline—Vol. %	46.0	46.4
Cracked Gasoil—Vol. %	51.2	38.8
Excess Butanes—Vol. %	2.0	11.3
Dry Gas—Wt. %	5.6	7.0
Coke Prod.—Wt. %	3.4	4.0
Motor Gasoline Properties:		
Gravity—°API	58.2	54.2
Reid V.P.—Lbs./sq. in.	10.0	9.5
Sulfur—Wt. %	0.246	0.08
Aniline No.—°F	82	63
Acid Heat	186	32
Octane No.:		
CFR-M Clear	77.9	82.6
CFR-M + 1.5cc T.E.L.	81.2	87.0
CFR-R Clear	91.3	92.7
CFR-R + 1.5cc T.E.L.	95.3	96.7
ASTM Motor Dist.:		
Distillate + Loss %		
@ 158 °F	18.5	20
@ 212 °F	38.0	39
EP, °F	401	410
Recovery—%	97.5	98
Cracked Gasoil Properties:		
Gravity, °API	22.7	29.0
ASTM 50% Dist., °F	605	481
Aniline Point, °F	124	113

The clear CFR motor octanes of the two gasolines are 12 to 15 points higher than would be obtained by conventional thermal cracking of the same stocks, and the clear research ratings 14 to 18 points higher. Lead susceptibilities are also excellent.

Catalytic gasolines of this character have good stability, and normally need only caustic washing and the addition of an inhibitor for motor-gasoline use. In cases of high-sulfur feed stocks, a light acid treat may also be required.

Considerable quantities of olefins and isobutane are also produced, along with an excellent grade of gasoil.

Many of the catalytic-cracking units now on war-time aviation gasoline production will be converted to motor-gasoline production in the post-war period. It is obvious that such conversion will play an important role in markedly increasing the overall quality of post-war motor fuels.

Safety in the Operation of Hydrogen Fluoride Alkylation Plants

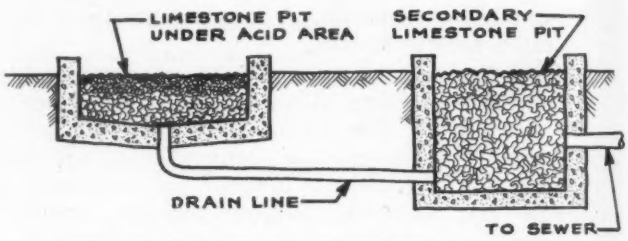
ROY BENSON
Universal Oil Products Company

Before the thirty-second National Safety Congress, Chicago, October 6, 1943

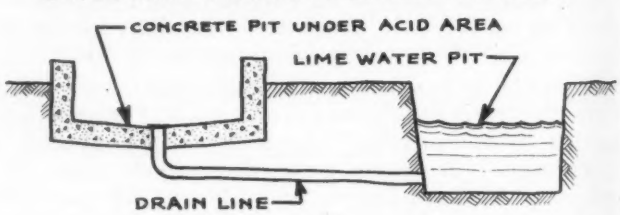
THE demand of our flying forces for a superior fuel having exceptional power for short-run takeoffs and for long-range bombing has proved a stimulus to the use of new tools — called catalysts — by the refining industry. These new tools present new problems to the safety engineer.

Anhydrous hydrogen fluoride (HF) is a catalyst widely employed in the production of alkylate, a major component of 100-octane aviation fuel. It is a colorless liquid, which boils at 66.7° F. When exposed to the atmosphere, it fumes or vaporizes strongly; and, because of its high affinity for water, it readily combines with the moisture of the air. The acid vapor thus formed looks very much like steam. Its presence in the atmosphere can be readily detected by its strong, pungent odor and irritant property.

Like high-temperature oil or vapor, HF is harmless when kept within the confines of the processing equipment. Oil or vapor at high temperature causes a thermal burn on anyone exposed to it, while HF produces a chemical burn. New measures, therefore, must be adopted and rigidly enforced to protect the personnel of plants employing HF. Methods of first aid and of medical treatment must be learned in order to care for injuries incurred through the failure to observe or to enforce the rules and regulations that govern the safe use and handling of this acid. Reliance must be placed upon the designer to provide the best available equipment for the HF alkylation plant and to incorporate features which will minimize accidental discharge of acid to the atmosphere. The operating management must be thoroughly impressed with the toxic and corrosive nature of hydrogen fluoride to the extent that the safety engineer will be given a free hand in providing the necessary protective equipment, first-aid supplies, instructional data, and authority to demand and enforce adherence to all rules and regulations for safety. Plant supervisors must be 100 percent cooperative with the safety department and, in fact, should bear the responsibility for the safe operation of the plant. The insidiousness of HF permits of no relaxation of intelligent supervision. Safe performance on the part of the operators, maintenance men, and others employed on the HF plant is essential; it will be obtained if they are adequately informed regarding the nature of HF and the proper manner of handling it. There should then be no need for cajoling or coercing to obtain compliance with rules and regulations for safety.



LIMESTONE NEUTRALIZATION SYSTEM



LIME WATER NEUTRALIZATION SYSTEM
FIGURE 1

The subject of safety in the alkylation plant may be considered from the following angles:

1. Measures incorporated in the plant design.
2. Protective devices auxiliary to the design.
3. Protective wearing apparel.
4. First-aid treatment of HF injuries.
5. Medical treatment of HF injuries.
6. Physical examinations of HF plant workers.
7. Some general precautions.

Plant Design

Many problems confronted the engineers in designing an HF alkylation plant. But regardless of assurances that the acid will stay in the processing equipment, the safety man must be wary for the human element factor cannot be overlooked. The designers, likewise, have adopted this attitude. Provisions, therefore, have been incorporated in the design to minimize the hazard of accidental release of acid to the atmosphere.

An exhauster system is provided with connections to all parts of the acid section of the plant where predictions might indicate the presence of acid on opening or disconnecting for adjustments, repairs, replacements, or sampling. This system also permits the removal of HF vapors from vessels and piping during shut-down for cleansing and inspection. HF is particularly adaptable to removal by evacuation, because of its relatively low boiling point.

The exhauster system discharges to a caustic-wash tower for neutralization of HF vapors before release to the atmosphere. The exhaust release is located

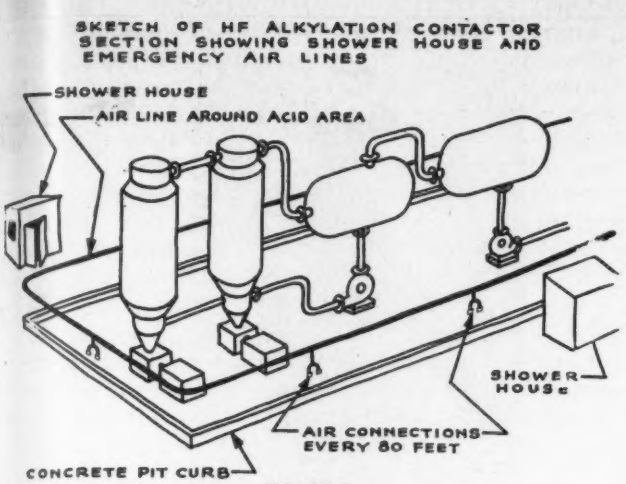

SKETCH OF HF ALKYLATION CONTACTOR SECTION SHOWING SHOWER HOUSE AND EMERGENCY AIR LINES
SHOWER HOUSE
AIR LINE AROUND ACID AREA
SHOWER HOUSE
AIR CONNECTIONS EVERY 80 FEET
CONCRETE PIT CURB

FIGURE 2

away from the plant area, so that in case of failure of the caustic system the hazard to persons in the plant area will be minimized.

Disposal of Spills

Quick neutralization and disposal are necessary when there are accidental spills of acid in the plant area caused by failure to evacuate properly; by failure of the seals on pumps, contactors, or valves; by rupture of lines or vessels; or by any other untoward incident. For this purpose, the acid-carrying equipment is located in a pit containing a 2-foot depth of limestone, with the pit wall extending about 18 inches above the base level to serve as a retaining wall. This wall or curb serves also as a boundary for the restricted acid area. The limestone neutralizes the acid which it contacts so that its spread to the surrounding area is avoided; and contamination by seepage of water through the soil is prevented, as well as corrosion of underground piping and foundation work.

Limestone that has reacted with the acid is removed, and new limestone is laid down after the area is thoroughly washed with water. The spent limestone is deposited in an isolated location away from any processing equipment, where it is allowed to hydrolyze slowly.

An auxiliary limestone pit is provided outside the acid area into which water and/or acid following major spills may drain from the acid area pit for further treatment.

An acid area pit which does not contain limestone may also be used. In this case water washing is done immediately following the spills; and dilute acid solution is then neutralized in an auxiliary pit containg limewater, and the acid is precipitated out. The precipitate is subsequently removed and buried, the liquid being discharged through the sewer after it becomes neutral. (See Figure 1.)

Disposal of spent acid should receive continued attention so as to avoid contamination of drinking water and pollution of rivers and streams.

Hazard to Personnel

The possibility of accidental discharge of acid presents a hazard to the personnel. For the prevention of injury to those exposed to acid contact by accidental discharges, emergency shower and first-aid booths must be provided in order that immediate first-aid measures can be taken. The showers should be operated by treadles so that both hands may be free for removal of clothing. Warm water should be available in winter weather to avoid sudden shock, which may aggravate a similar condition caused by the acid burn itself. The booths should contain bubbler fountains for effective flushing in the treatment of eye injuries. They should also be equipped with the necessary first-aid medicaments and other supplies which will be discussed later.

In order that exposure may be minimized when work must be performed at or near leaks of acid, portable air movers are helpful to create a windward side when the atmosphere would otherwise be still. Obviously workmen should always station themselves on the windward side to avoid blow of acid toward themselves. Compressed air may be used in lieu of portable air movers, provided sufficient capacity and properly designed nozzles are available.

For rescue work or other duties in an atmosphere that is heavily laden with HF vapors, a complete coverage, air-supplied suit is necessary. For the air supply the acid area should be encircled with an air line with quick attachment hose connections spaced at close intervals. (See Figure 2.)

Burns resulting from the handling of tools that have been used where acid may have contacted them are avoided by placing receptacles containing sodium bicarbonate at locations convenient for neutralization and removal of any acid film. All tools must be doused in the solution promptly after use and before they are returned to the toolroom. This precaution is a protection primarily to those who may use or handle tools after they have been taken from the acid area where workmen would normally wear acid-proof gloves.

The pit wall mentioned previously constitutes the boundary around what may be termed a restricted area. This wall should be painted a distinctive color, preferably red, and plainly marked at fairly close intervals with signs reading "Restricted Area—Do Not Enter Without Permission." Delegated persons should be granted the authority of giving this permission. The requirement of permission, of course need not apply to operators regularly assigned to the HF alkylation plant, but it should apply to all others, including maintenance and repair workers. Those granting permission should learn the purpose of each request and then stipulate the type of protective apparel which must be worn. Supervisors and operators should watch the workers in the area, and report any infractions of rules pertaining to the wearing of protective apparel and the performance of duty.

Protective Clothing

Various types of jobs in the acid area requiring specific protective wearing apparel may be classified as follows:

A. Routine operations.
B. Plant alterations.
C. Maintenance.
D. Emergency or hazardous work.

Protective apparel recommended for the various classes of work is as follows:

Class A clothing, which consists of neoprene-soled work shoes, a rubber cap, a wide-angle face shield, and neoprene gauntlet gloves, is worn only when making a visual observation of the plant under normal conditions. Any person entering the acid area must wear this equipment; his gloves must be on and his face shield down when he crosses the re-

Class A Clothing consists of Plastic Shield with Neoprene Cap, Neoprene-soled Shoes and Gloves of Identical Material.

Class B Clothing consists of Neoprene Cap, Plastic Face Shield, Acid Coat and Neoprene-soled Shoes.

Class C Clothing consists of Acid Hood and Coat, Rubber Boots with Gauntlets and Overalls of Neoprene.

Class D Clothing consists of Hood with Chemical Cartridge Filter and Plastic Window (the Hood is equipped with Bump-proof Valve), One-finger Gloves, Overshoe boots and Neoprene Hose.

stricted-area boundary line. The shoes protect his feet against acid that may have condensed on the ground or on the stairways, platforms, and runways. The cap offers protection against acid dropping from above. The gloves are extremely essential, because any surface touched may have an acid film; or in performance of various duties there may be slight discharges of acid vapor, which may come into contact with the unprotected hands by way of tools and other objects that may be handled. The wide-angle feature of the face shield is a protection also to the ears.

When changes are to be made in plant operation, Class B clothing should be worn. This clothing includes a rubber or neoprene acid-proof coat, together with the Class A apparel mentioned above; i.e., neoprene-soled work shoes, rubber cap, face shield, and neoprene gauntlet gloves. The purpose of the coat is to provide protection for the arms and body of the workman. The possibility of pump and packing failures, for instance, when making adjustments to operating conditions prompts this recommendation for additional protection.

Clothing of Class C classification is recommended whenever acid equipment is to be opened up for inspection or repair. Rubber boots and neoprene acid-proof garments, which include a coat, overalls, gauntlet gloves, and a hood, are worn. Rubber apparel may be substituted if neoprene is not available. Class C clothing protects the wearer against the discharge of acid or acid vapor which may not have been previously drained or evacuated from the inside surface of the equipment.

Class D protective apparel has been specifically designed for work in acid vapor atmospheres where complete protection might be needed, as in the case of repairing an extremely large leak, or of working where the concentration is higher than that which could be handled by a cannister mask. The clothing consists of a neoprene coverall suit provided with the novel feature of admitting a compressed fresh-air supply to the body as well as the headpiece. Through the admission of air to the body portion, the wearer is enabled to move about in comfort; in addition, the air prevents acid vapor from entering the suit because of the air passing out. The constant rush of air blowing out around the neck and other openings makes it possible for the wearer to work safely in any concentration of acid vapor-air mixtures. This feature also is a safeguard in case the suit is torn; the vapors in this instance as well could not enter.

The air supply for this suit is taken off the air line referred to previously as having been installed for that purpose. Operators and others should be required to practice donning the suit so that there will be no loss of time when an occasion arises when the suit should be used. The alkylation plant should be provided with a large and a small suit, and both suits should be readily available at all times and regularly examined for condition.

Safety apparel should be thoroughly washed with water before it is laid away. A suit can be conveniently washed before the wearer takes it off.

Although plant design, protective equipment, and supervision are excellent, accidents may occur; consequently the treatment of casualties has been carefully studied, and facilities for rendering such treatment have been provided.

Prompt action is of the greatest importance for successful treatment. For example, when acid has come into contact with the skin, the area affected should be immediately flushed with water for at least 10 minutes. The burning sensation of extremely low concentrations may not become apparent for some time after contact, particularly if the acid has touched the tough thick skin of the hands or feet; therefore, the area should be washed even though there is only a suspicion of an acid contact. High concentrations of acid penetrate the skin rapidly and produce a stinging sensation almost immediately. The warning is sufficient to cause the worker to lose no time in starting first-aid treatment. A delayed-action burn may cause a painful, deep-seated injury that requires medical aid; therefore, splashes of all kinds should be treated for acid burns.

First-Aid Treatments

The following first-aid treatment is recommended:

1. Flush well with water for at least 10 minutes.

2. Apply, with cotton, a 10 percent solution of ammonia (10 percent of 28 percent aqueous ammonia solution), and rinse with water. Do not use household ammonia unless none other is available. It is preferable to use a sterile solution made by a pharmacist in accordance with the U.S.P.

3. Rub well into the affected area the special magnesium oxide-glycerin HF burn salve which should be on hand in the first-aid and emergency booths. Blisters, if any, should be opened with a sterile instrument by a competent person.

With most acids, merely washing with plenty of water and neutralizing, if done quickly enough, are sufficient to stop their action. HF, however, has a double action on the skin: first, there is the acid, which must be neutralized; second, there is the fluorine ion, which must be precipitated. Therefore, it is necessary not only to wash the area thoroughly and apply ammonia, but also to use magnesium or calcium in a form so that it will precipitate the fluorine ion. If there is delay in treatment, or neglect, HF penetrates deeply into the tissues and causes deep-seated burns, which have been compared by one authority to those produced by high-voltage electricity. Blisters are opened so that the salve will reach the acid underneath and stop its action quicker. If the acid has penetrated into the tissue, the magnesium oxide paste applications will not be sufficient to prevent a bad burn, and it will be necessary to obtain medical aid for the injection of 10 percent calcium gluconate or 20 percent magnesium sulfate by hypodermic around and under the affected area. This application will form a calcium or magnesium barrier around the burn and prevent further destruction.

Some of the most painful burns experienced have been under the fingernails. Some physiologists believe that the acid penetrates the nail itself, and when under the nail, starts its destruction of tissue in a particularly tender spot. If the calcium gluconate or magnesium sulfate can be injected through the nail or around it, the pain may be alleviated.

The above treatment is not the only one advocated by manufacturers of hydrogen fluoride. A number of authorities favor prolonged washing with water to draw the acid from the tissue by osmotic action. One worker with HF recommends prolonged washing followed by ice-cold alcohol immersion. Even the most painful burn can be rendered almost painless by holding the affected part in ice water; but when it is withdrawn from the ice-water, the pain may commence again.

Breathing of Fumes

It is almost impossible for anyone consciously to inhale enough hydrogen fluoride to harm himself seriously; the acid gas is too pungent for voluntary inhalation. A study of the available literature on this subject showed only one case of a fatality from HF inhalation. The possibility of being rendered unconscious and becoming injured appears to exist only if a man is trapped where gases are suddenly

released. Should this occur, the following procedure is recommended:

1. Remove the patient to fresh air, free from drafts.
2. Treat skin burns by the prescribed treatment.
3. Make patient rest.
4. Reassure the patient and discourage him from coughing. Cough syrup should be provided in each shower house.
5. Apply artificial respiration if necessary.
6. Keep the patient warm, because he will be suffering from shock.
7. Call the doctor on all inhalation cases.

Eyes

Eye injuries among workers handling HF have been rare; strict adherence to eye protection is apparently the reason. Nevertheless, bubbler fountains should be installed in each shower house for flushing and washing the eyes in case of injury. Bottles containing a saline solution should also be available for neutralization. Beyond the administering of water and saline solution medical aid should be sought.

In view of the heretofore limited use of hydrogen fluoride and consequent lack of knowledge or widespread information regarding the treatment of HF casualties, a booklet on the subject was prepared by Anton J. Carlson, physiologist of the University of Chicago, for distribution to medical men located in the vicinities of the HF alkylation plants. Copies of this booklet, *Treatment of Hydrofluoric Acid Casualties,* may be secured from the Universal Oil Products Company. Managements of plants have been requested to place the booklet in the hands of their industrial doctors and nurses.

"Fluorosis"

Whenever the subject of fluorine or fluorine compounds is mentioned, the work of Roholm on cryolite workers in Denmark comes to the fore. Roholm found that these men, who inhaled fluorine-bearing dusts over a period of many years, incurred what he called "fluorosis." After years of work the men became slightly stooped, and their backs stiffened. X-ray examinations disclosed that their backbones and pelvis bones had increased in size, and posthumous examinations showed a surplus of fluorine.

When hydrogen fluoride was proposed as a catalyst, the records of workers in plants where this material was made were investigated for evidence of fluorosis. One of the plants had been taking X-rays of its men every year, but had found no cases of fluorosis. Another plant which had been making HF for over 10 years had all of its men X-rayed, but none had any evidence of fluorosis. One HF manufacturer had been giving his men physical checkups for more than 5 years but had never been able to detect any sign of the disease.

The men working in alkylation plants have even less chance of contacting fluorine than those in the acid-manufacturing plants as the alkylation equipment is all outside while the hydrofluoric acid retorts are all inside. However, our men are always examined before they are assigned to HF alkylation plant operation. If there are any abnormal bone or joint conditions, the men are eliminated from further consideration. X-ray examinations will be repeated annually for confirmation of our present belief that a worker in normally good health, when assigned to HF alkylation plant operation, needs have nothing to fear regarding any ill effects as a result of this employment.

In addition to the X-ray tests we advise preemployment analysis of the urine for fluorine content. From work done by Machle and Largent, of Kettering Institute in Cincinnati, it has been established that the fluorine content of the urine is an indication of the fluorine intake of the individual. If the normal content is known, then a check analysis every six months will show any amount absorbed. Arrangements have been made with Kettering Institute to analyze the samples. We believe that these tests will prove to HF alkylation plant personnel that there is no fluorine intake as a consequence of their employment.

For the purpose of detecting leaks which may cause contamination of cooling water with HF, a pH recorder is employed on the water outlet from the plant. The leakage of acid into the water system, or vice versa, would present a serious problem of corrosion. Contamination of water in streams or rivers into which waste water from the plant is discharged might cause complaints on the part of public health agencies and fish and game authorities. Only through carelessness and lack of attention, however, would this eventuality arise.

Spent bauxite from the bauxite treaters, contaminated limestone from the neutralizing pit, precipitated calcium fluoride, or waste materials which cannot be easily and completely decontaminated must be disposed of in a safe manner and in a place where they will not constitute either a hazard or a nuisance. These materials should be dumped into a pit over the bottom of which has been placed a layer of lime. Lime should also be spread on top of the dumped material so that any free fluorine remaining in it will be converted to stable calcium fluoride. Flammable materials which may contain HF should be burned.

Identification of all piping in which there is or may be hydrogen fluoride should be in accordance with the color scheme of the A.S.A. code. This code stipulates yellow as the color for hazardous materials. Lines containing other materials are to be painted in accordance with the respective colors specified.

Acid spills on floors, stairways, and platforms should be immediately neutralized with soda ash. Small pans containing this chemical should be provided to catch drippings.

All equipment which has been in acid service should be thoroughly neutralized before it is turned over to shop or warehouse, or placed elsewhere for subsequent disposal where it may be handled with the bare hands. A strong soda ash solution is recommended as a neutralizer. Shop repair and maintenance men, warehouse men, and others should be warned of the danger of HF so that they will be on the alert for any indication of acid.

Traffic through the acid area should be confined to the men whose duties require it. All others should walk around the area.

Whenever possible, workmen should station themselves on the windward side when making valve adjustments, taking up packing on pumps, lubricating cocks, or tightening flanges. In case of serious leaks requiring exit from the immediate area, workmen should retreat in the windward direction.

There should be no relaxation in compliance with rules and regulations pertaining to the use and handling of hydrogen fluoride. Strict supervision must be in force at all times.

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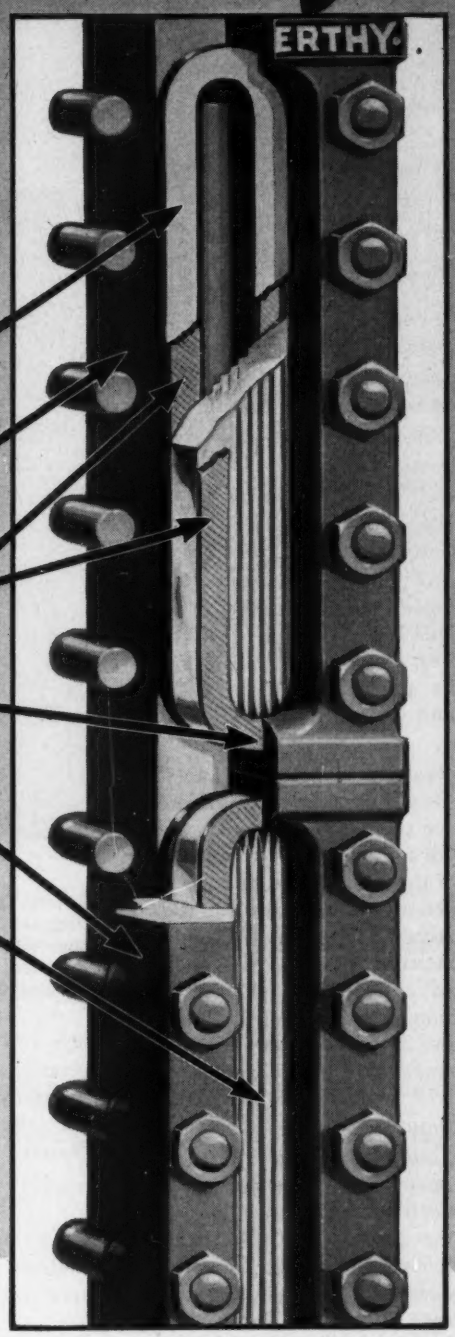

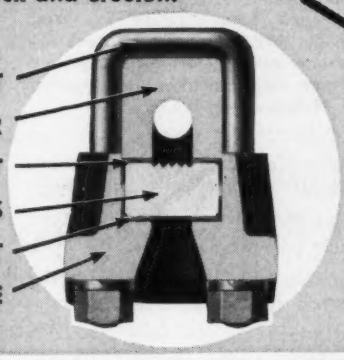

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Cycling Operations And Potential Use of Products

JAMES E. PEW

I HAVE chosen "Cycling Operations and Potential Use of Products" as my subject in order that I might emphasize the major role that those operations are today playing in wartime production and will continue to play upon the return of peace. The coming months will see the Paloma Cycling Plant, in which some of you are personally interested, placed on stream, adding 7500 barrels per day to the nation's supply of those light hydrocarbon fractions which are volumetrically equivalent, by virtue of their natural highly refined state, to two or more times their production in terms of crude oil. It is wise, then, to review the state of the industry—to consider briefly the past, but more fully the present and future scope of cycling operations.

It is interesting to note that two Californians, Bruce H. Sage and William N. Lacey, have played an active role in the amassing of knowledge pertinent to this offshoot of the natural-gasoline industry. At the request of the American Petroleum Institute, they early undertook a comprehensive study of the complex phenomena associated with retrograde condensation in the reservoir. That investigation, as you know, culminated with issuance of an authoritative text, "Volumetric and Phase Behavior of Hydrocarbons."

The authors have continued their research, however, on the nation's condensate wealth, which today lies essentially in the Southwest. In the last decade, condensate field discoveries in that area have risen yearly, reaching a peak of 44 percent of the total number during the first half of this year. But there are no strict geographic—only geologic—limitations: such fields have been found in the North, in the Turner Valley field of Canada; in the East, in the Oriskany fields of the Appalachian area; in the Rocky Mountain region, where construction of a cycling plant for the Walden area, embracing the North and South McCallum anticlines of Jackson County, Colorado, is now under consideration; and on the Pacific Coast at Kettleman Hills, Paloma, South Coles Levee and Helm. Condensate reserves do not appear large in the petroleum wealth of the United States, representing only about 5 percent of the total, but they assume herculean stature through their potential use.

JAMES E. PEW

Director of the Natural Gas Natural Gasoline Division, Petroleum Administration for War, gave this summary of cycling development before the annual meeting of the California Natural Gasoline Association in Los Angeles, November 5, 1943.

Started in South Texas

The first plant for cycling gas-condensate production was placed in operation early in 1937 in the Agua Dulce area of South Texas, following what might be termed "pilot plant" operations at the Big Lake field in Texas. Unitization was then slowly building a case for itself, but unit operation for the field was not undertaken. Today four plants are operating at Agua Dulce, but they, through coordination of effort, are effectively removing the increasingly valuable lighter hydrocarbons from the condensate sands. And it is from Agua Dulce and Stratton, both appearing to be major producing problems upon their discovery, that gas, having served its purpose of expelling liquefiables from the reservoir, will be sent to the Appalachian area this coming year and thereafter through a gas-bearing "Big-Inch."

In the ensuing six years, cycling plants have passed through stages suggested by the natural-gasoline industry —simple separation, stage separation, refrigeration and stage separation—until today the absorption type plant, capable of operating at pressures up to 2000 pounds, is in use almost exclusively. Modern cycling-plant design has permitted conversion to embrace technologic advancements as they were made.

With present-day design, cycling plants can function either in complete or partial coordination with refinery operations. When cycling operations are completely coordinated with those at the refinery, the wet gas is processed initially to effect removal of all liquefiables, with extraction efficiencies running as high as 85 percent on butanes, and 99 percent on the heavier hydrocarbons. The fractions so recovered are then separated into (1) an ethane-propane mixture which in the absence of a market may be injected into the producing formation in liquid form; (2) a mixed butane fraction, which is carried to the refinery by pipe line; (3) a fraction containing pentanes plus, which is delivered to the refinery by pipe line or truck; and (4) a residual oil, suitable for use as absorption oil.

It is a plant of the type just described which is currently under construction at the Paloma field, Kern County, California, with delivery of products scheduled to the new 100-octane plant of The Texas Company refinery. It should be noted, however, that this is by no means an inflexible arrangement. Modern cycling-plant design readily permits of partial dissociation with the refinery. Through extensions of minor magnitude, plants can be altered for semi-independent operation.

Partially integrated operations are now in common use. In the course of such operations, the ethane-propane mixture may be returned to the formation and the butane fraction transported to the refinery by pipe line, as before. The heavier products, however, are processed to yield a finished grade of fuel — either motor fuel, or 87- or 91-octane aviation fuel—while the naphtha

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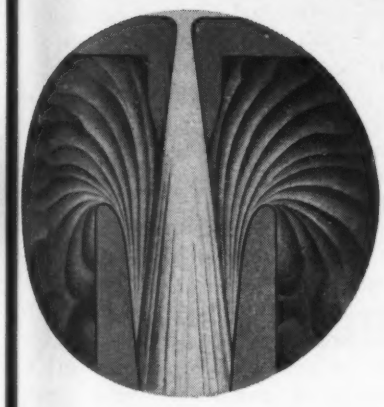

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(separated when aviation fuel is produced), kerosine, and absorption oil are separated and retained or marketed. Only a minor change in plant operation is required to yield motor fuel or high-octane fuels, as desired, again illustrating the extreme flexibility of cycling-plant operations. The naphtha yield in the production of high-octane fuels has been found to have a market as charging stock for use in the thermal-cracking "quick butadiene" process. Plants in the Agua Dulce-Stratton area of South Texas may be cited as typical of those operating in partial coordination with refineries.

In a modification of this type of operation, the cycling plant may again return the ethane-propane mixture to the producing formation and separate the butane fraction into normal butane and isobutane. The normal butane is then distributable by tank truck in the form of a liquefied petroleum gas, or as a chemical raw material, while the isobutane is delivered to the refinery for alkylation. The heavier fraction is then made to yield motor or 87- or 91-octane fuel, as desired. The disposition of the naphtha, kerosine, and absorption oil produced has earlier been noted. It is evident, then, that the modern cycling plant can be of major importance in today's wartime production, while it is further evident that minor changes in post-war plant operation will make available a steady flow of valuable peacetime products.

The hastening of Allied military operations, with the extension of major operations to two main theaters of war, European and Pacific, has of necessity been accompanied by heightened demands for aviation fuels. Deputy Petroleum Administrator Ralph K. Davies stated on October 21 that production of these high-octane fuels has increased over 400 percent since the outbreak of war. The lighter hydrocarbons obtainable through cycling have played a highly significant part in making possible that increase.

Aviation Fuel

Cycling operations are fundamental to the success of the aviation-fuel program, as they make available a substantial portion of the isobutane which goes into the production of iso-octane alkylate, isopentane, and base stocks. It is accordingly altogether possible to produce a finished 100-octane aviation fuel from raw material derivatives of the cycling plant.

But what of the economic considerations involved in cycling operations? Because of your distance from the center of these operations—PAW District 3—you men of the California natural-gasoline industry are probably not overly familiar with such considerations. It may be well to digress momentarily, then, to look at condensate field development as expressed in terms of dollars and cents.

Unitization of condensate fields, which permits of a characteristically conservative development, is capable of yielding returns equally as profitable as those obtained in the closely-spaced competitive development of oil fields. Unitization has long been a stumbling-block in the path of oil and gas conservation, and nowhere more so than in California. Last month E. E. Pyles, chairman of District 5 Petroleum Industry Production Committee, speaking on "Sources of California's Future Oil Supplies" before the Interstate Oil Compact Commission, stated:

"The principle problem in California . . . is not the technique of recovery but rather the problem of educating our producers and land-owners to the desirability of such procedure and the necessity of unitized or cooperative work as a prerequisite to successful recovery methods. Oil production in this state for the past 25 years has been on a highly competitive basis with most of our fields highly diversified in their surface ownership . . . Unless, and until our operators are fully conversant with this problem and are willing to throw into the pot their individual properties for the greater reward of increased recovery, little can be accomplished of a substantial nature."

Value of Condensate

The natural-gasoline operator, living on the waste product of the oil operator, has in the past unkindly but perhaps realistically been termed a scavenger. I believe that his physiognomy is today altering in the eyes of the oil industry, and that he no longer appears a hungry vulture, but rather a wise old owl. He has played a prime role in making the oil industry conservation-conscious, and today that industry is learning another lesson from him through the efficacy of his unitized cycling operations, doubly necessary in condensate development.

In wartime condensate has assumed, through its natural highly-refined state, a value superior in many instances to that of crude oil. In this connection, data compiled by the Subcommittee on Aviation Gasoline Potentialities established by the PAW District 3 Natural Gas and Natural Gasoline Committee are of interest. It was disclosed that aviation grade naphtha could be made available through cycling operations for only 28 percent of the critical material expenditure required for well-head production of this valuable fraction in crude oil. Following the extensive study undertaken, the subcommittee issued three recommendations which indicate fully the potentialities of cycling-plant operations. These were:

1. Development of condensate fields for cycling-plant operations, including installation of equipment for segregation of components necessary to the aviation-fuel program.
2. Increased recovery and segregation of aviation-fuel materials through installation of additional facilities in plants now operating.
3. Utilization of components such as ethane-propane mixtures, now being produced but not entering into the war program, for increased production of super aviation fuel.

Saving of Material

Some conception of the saving in both critical material and capital in the production of lighter hydrocarbons from condensate fields may be afforded by reference to the recently prepared program determination of the Natural Gas and Natural Gasoline Division of the Petroleum Administration for War, which calls for construction capable of yielding an additional 35,000 barrels per day of condensate, natural gasoline and lighter hydrocarbons. The estimated capital investment is $28,800,000, of which $10,800,000 covers the cost of the wells. The expenditure in critical material is estimated at 58,350 tons, of which 28,350 tons will be utilized in these well completions.

The completion alone of oil wells for production of an equivalent volume of similar hydrocarbons would total $55,800,000, while production of an equivalent volume of crude alone would cost $31,500,000. In terms of critical material, expenditures of 216,000 tons and 105,120 tons respectively, would be involved. In terms of processed production and reinjection in condensate fields versus well-head production in oil fields, the latter would cost nearly twice as much in terms of capital investment, and nearly four times as much in terms of critical materials.

Returning to the consideration of cycling-plant products, I should like to separate them into four major groups, examining them more or less in the order of their availability for utilization. Such a grouping affords:

1. Motor fuels and condensates.
2. Butane and pentane fractions.
3. Ethane-propane mixtures.
4. Dry gas.

In the past, base-motor-fuel and condensate stocks have not appealed too highly to refiners, because of their relatively low volatility and anti-knock rating. These factors, although offset to some extent by a high susceptibility to leading, have prompted refiners to reform base fuels from cycling operations

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into higher octane fuels. On the basis of cost, however, the refiner cannot compete with the cycling-plant operator, and satisfactory motor fuels, including loaded grades, can be produced in the field for less than 2½ cents per gallon. With declining crude discoveries and increasing condensate discoveries now the order of the day, increased use of cycling-plant fuels may be looked for in the future. The cycling plant operator can readily adapt his operations, at slight cost, to embrace the major technologic advancements of today and tomorrow.

Processing

In processing the butane and pentane fractions separately, isomerization, polymerization, hydrogenation, dehydrogenation, and alkylation methods are employed. However, in the production of super fuels and products, no process may be looked upon as being of static design: new methods must be constantly explored with a view toward making more efficient use of these lower-boiling fractions, which promise to be of even greater value in the post-war period. Their potentialities mark them as being among the most valuable of the hydrocarbon fractions.

The large quantities of liquid ethane-propane mixtures presently separated in cycling operations, but returned to the producing horizon in the absence of a market, will find that market with improvement of transportation, storage techniques and chemical development. They bear consideration, in such event, as industrial liquefied petroleum gases. Several other possibilities suggest themselves: first, that they are potentially useful as manufactured gas enrichment agents, and, second, that inasmuch as it has been proved possible to produce carbon black from liquid hydrocarbons, and since higher yields have been noted with higher ethane content of fuels used, they would appear to be of potential importance in the production of this necessary item, in which 11 percent of the nation's total gas consumption was utilized this past year.

Again, with the development of modern methods of regenerative cracking, cycling products are available for the production of such chemical raw materials as acetylene, ethylene, propylene, butadiene, and benzene. Generally speaking, today's super war products are synthesized from chemically active unsaturated hydrocarbons such as these, either produced or producible with cycling products as basic constituents. Ethylene and propylene so obtained afford unsaturates of prime value in the production of neohexane and cumene. In combination with benzene, ethylene may also yield styrene, a principal component of Buna S rubber. By rearrangement or recombination, hydrocarbons obtainable in the cycling plant can provide the raw materials for any of the five basic types of synthetic rubber, from which airplane and other tires, innerseal semi-solids for gasoline tanks and tubes, and other products of diversified nature may be derived.

Use of Dry Gas

When all liquefiable hydrocarbons have been removed from the condensate reservoir, 85-90 percent of the original gas content will still be contained therein if maximum production has been obtained through reinjection of residue gas. This dry gas, having performed its initial task of expelling liquefiables from the reservoir, is then available for use as fuel, for gas lift or repressuring in another field or another horizon or for conversion into useful products.

Rapid developments in petroleum chemistry, particularly since 1930, have shown that natural gas will react when activated by the efforts of heat, pressure, chemical reagents, and light; and that these reactions can be made to proceed at practicable conditions, especially if catalysts are employed. As these results became known, the possibility of a synthetic organic chemical industry based upon these reactions became apparent, and today this industry is large and growing rapidly. It would require a volume to set forth all the potential uses of natural gas and that volume would be obsolescent prior to completion. As Dr. Gustav Egloff, our foremost hydrocarbon protogonist, has so ably said:

". . . if we start with methane gas alone, all of the known synthetic products that man has produced in organic chemistry can be derived . . . Any synthetic product can be produced at a price; the hydrocarbons are all potentially available to be converted into the manifold products that man requires in a modern world."

Thus the natural gas being reinjected and stored for future use becomes of increased value with each technologic advance. As an example, today in wartime, synthetic ammonia continues to find itself an important base material in the production of munitions. In the production of synthetic ammonia the most difficult and expensive ingredient to obtain is hydrogen. Today approximately 50 percent of the emergency synthetic ammonia is manufactured with hydrogen derived from natural gas with a great saving in investment, time and critical materials.

Dry Gas to Motor Fuel

One of the outstanding potential uses of dry natural gas is the synthesis of liquid hydrocarbon fractions by means of a process commonly referred to as the Fischer-Tropsch process. The production of motor fuel by means of this process, in this event making use of a solid fuel (coal or coke), is now in commercial use in Germany. It is interesting to note that an estimated 50 percent of Western Axis oil is obtained through synthesis, and that the aviation-fuel derivative reportedly will bear favorable comparison with our high-octane products. With natural gas as the raw material, three steps are involved: reforming to water gas (hydrogen and carbon monoxide), synthesis into liquid hydrocarbon fractions, and finally recovery and separation. The three steps are already being practiced separately on a commercial scale, and in all likelihood a combination commercial installation will be realized in the near future. Gasoline, fuel oil, and heavy oil will thereby be made available under favorable economic conditions to augment our declining petroleum resources.

Oxygen is today being introduced into the hydrocarbon molecule on a commercial scale, but the mixture of products so obtained makes recovery and separation difficult. A process should be available in the near future, however, whereby natural gas may be converted into formaldehyde, with a high degree of purity. Through this process, natural gas will become available to the expanding plastics industry in the form of this basic raw material.

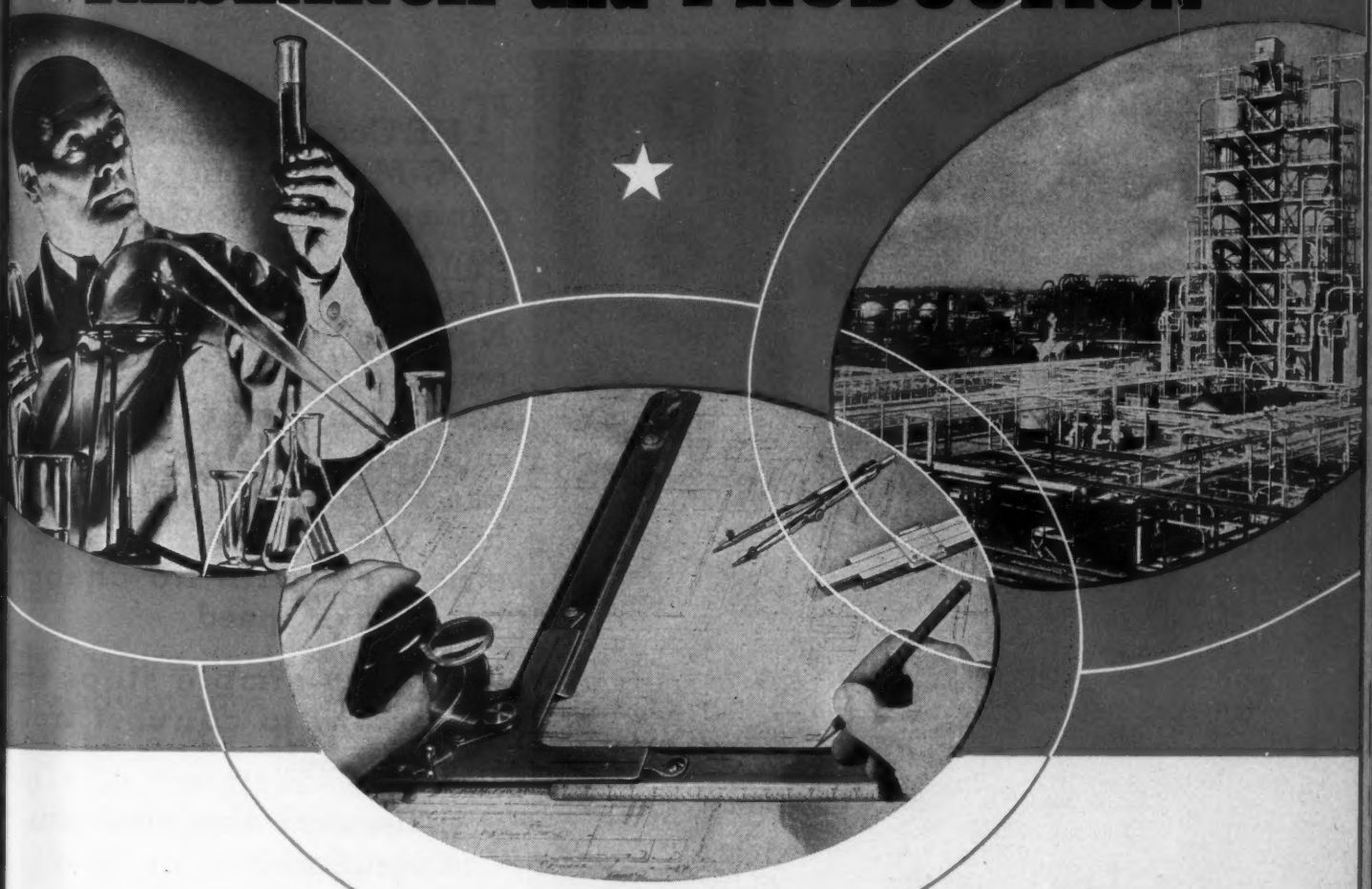
Of the total current 260,000 barrels daily of natural gasoline and cycling plant products, it is estimated that one fourth is produced in cycling operations. Plants now being constructed—among them the Paloma plant—will materially add to the present cycling-plant production, while additional construction programmed by the Natural Gas and Natural Gasoline Division of the Petroleum Administration for War for completion by the end of next year will result in cycling-plant production approaching 40 percent of the total production of natural gasoline and allied products. Such operations are, then, obviously destined to play an ever increasing part in the recovery and utilization of the lighter hydrocarbon fractions, both in the war and post-war periods.

It is not possible to prophesy the extent of the role which cycling operations will play in future development in California; but it is possible that deeper drilling will result in the discovery of additional condensate pools. But whatever the importance of the role that cycling operations may assume here, I am sure that you men of the natural-gasoline industry will fill that role capably.

McKEE REFINERY ENGINEERING

. . . the link between

RESEARCH and PRODUCTION



LABORATORY progress can be converted into practical production only by sound refinery engineering. The McKee organization is well qualified by personnel and experience to perform this function.

McKee process specialists keep up to date on all new developments in refining techniques. McKee refinery engineers are thoroughly familiar with the requirements of modern operation.

The McKee staff of technical experts and skilled construction personnel, with many years of world-wide experience, provide a *complete* service capable of handling all phases of your refinery project in *one* organization.

Arthur G. McKee & Company

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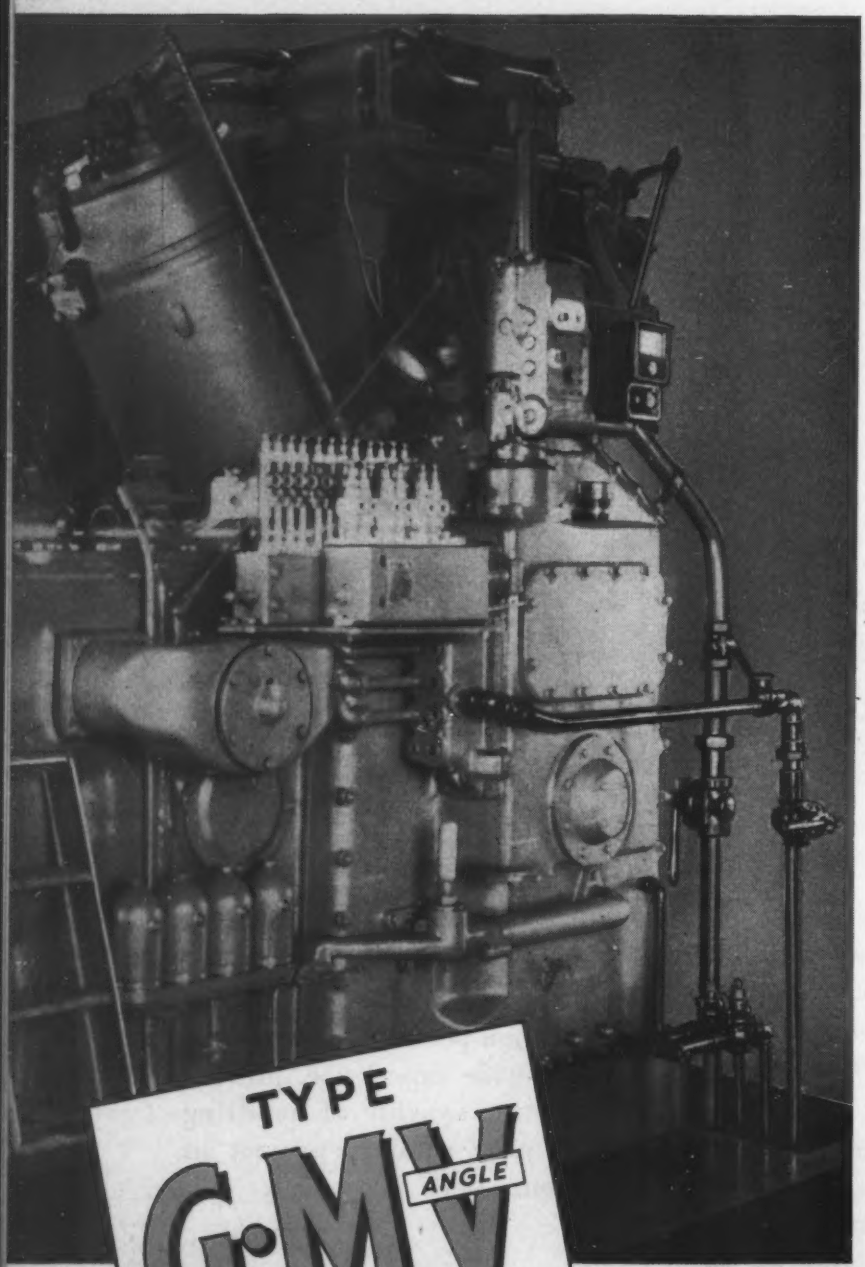
COMMERCE BUILDING
HOUSTON, TEXAS

Diesel

OPERATES AT TOP EFFICIENCY ON EITHER FUEL



THE Cooper-Bessemer Type G-MV has long been recognized as an outstanding power unit for oil field, pipe line and refinery service. Now, by virtue of practical research, skillful engineering and design, the G-MV is being built for either diesel or gas operation. With either fuel, this engine runs at top efficiency, with no change in rating or speed.

Only four simple steps are necessary to convert from gas to diesel:

1. Remove the electrical ignition.
2. Remove the gas injection system.
3. Add diesel fuel injection pumps.
4. Add diesel fuel system.

To convert from diesel to gas

DIESEL AND GAS ENGINES

FOR COMPRESSORS, PUMPS, GENERATORS

or Gas

. . CONVERSION IS SIMPLE, EASY AND QUICK

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erse the steps indicated.

The ability of the G-MV to
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reater flexibility of operation
nd will result in increased
perating economies. Espe-
ially in war plants, faced with
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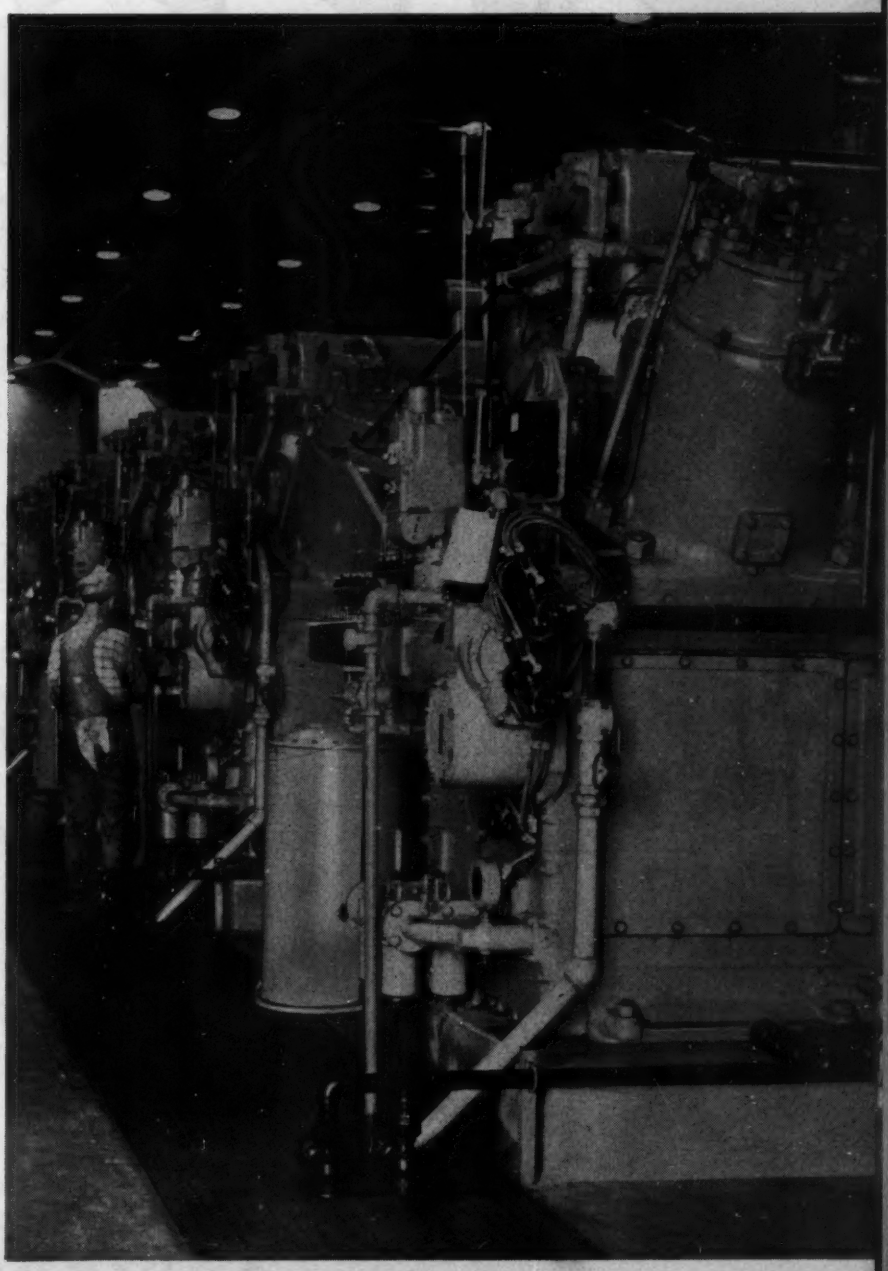
eacetime work after the war,
his feature will prove of
alue.

This feature is just one of
many advantages that distin-
uish the G-MV. Rugged and
imple in construction, re-
uiring minimum floor space,
t is built to stand up under
ears of continuous operation,
ith minimum time out for
aintenance or repairs. No
onder the Cooper-Bessemer
G-MV is known and preferred
y operators who want de-
endable, low-cost power.



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AVIATION GASOLINE

Alkylation

HIGHEST QUALITY ALKYLATE AT HIGHEST PRODUCTION LEVELS

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Votator REACTOR

A GIRDLER PRODUCT

The Votator Reactor employs substantially less critical metals. It is suitable both for new plant installations and for present plant extensions.

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★ SUPERIOR HEAT TRANSFER EFFICIENCY REDUCES SIDE REACTIONS

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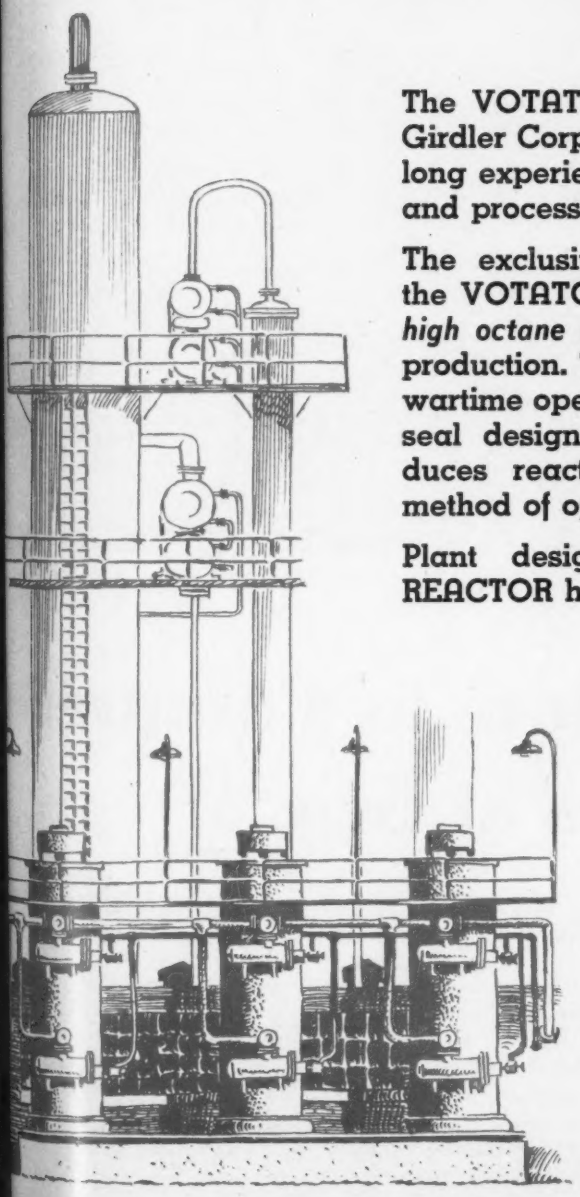


The VOTATOR REACTOR is a development of The Girdler Corporation and is backed by this company's long experience in designing many types of refinery and processing equipment.

The exclusive features listed above indicate why the VOTATOR REACTOR produces an alkylate with *high octane and high yield*—while maintaining peak production. This new unit also aids refineries' urgent wartime operations in other ways: Provides improved seal design. Eliminates external recirculation. Reduces reaction time. Offers greater flexibility in method of operation.

Plant designers will find that the VOTATOR REACTOR has exceptional advantages for the industry's alkylation program. Plant data is available on request. Investigate the VOTATOR REACTOR *before you decide on an alkylation unit.*

Attention: GREASE MANUFACTURERS

Votator equipment for continuous grease production is entirely different in design and function from the "Votator Reactor" described here. The VOTATOR for grease production combines instantaneous heating or cooling with continuous flow. It assures thorough mixing by high speed agitation at time of heat transfer. Write for special data questionnaire that will help us furnish specific information toward improving your grease production.

THE GIRDLER CORPORATION

VOTATOR DIVISION ★ LOUISVILLE, KENTUCKY

The Landlubber would check this one off as a total loss.

The Navy Knows How to Conquer Tanker Fires at Sea

Early in June hundreds of shipyard workers and naval personnel on duty along the Eastern Coast heard the low thunder of a tremendous explosion far at sea. They paused for a moment, grimly assumed that another Nazi-made torpedo had found its mark, and that the United Nations were poorer by another vessel.

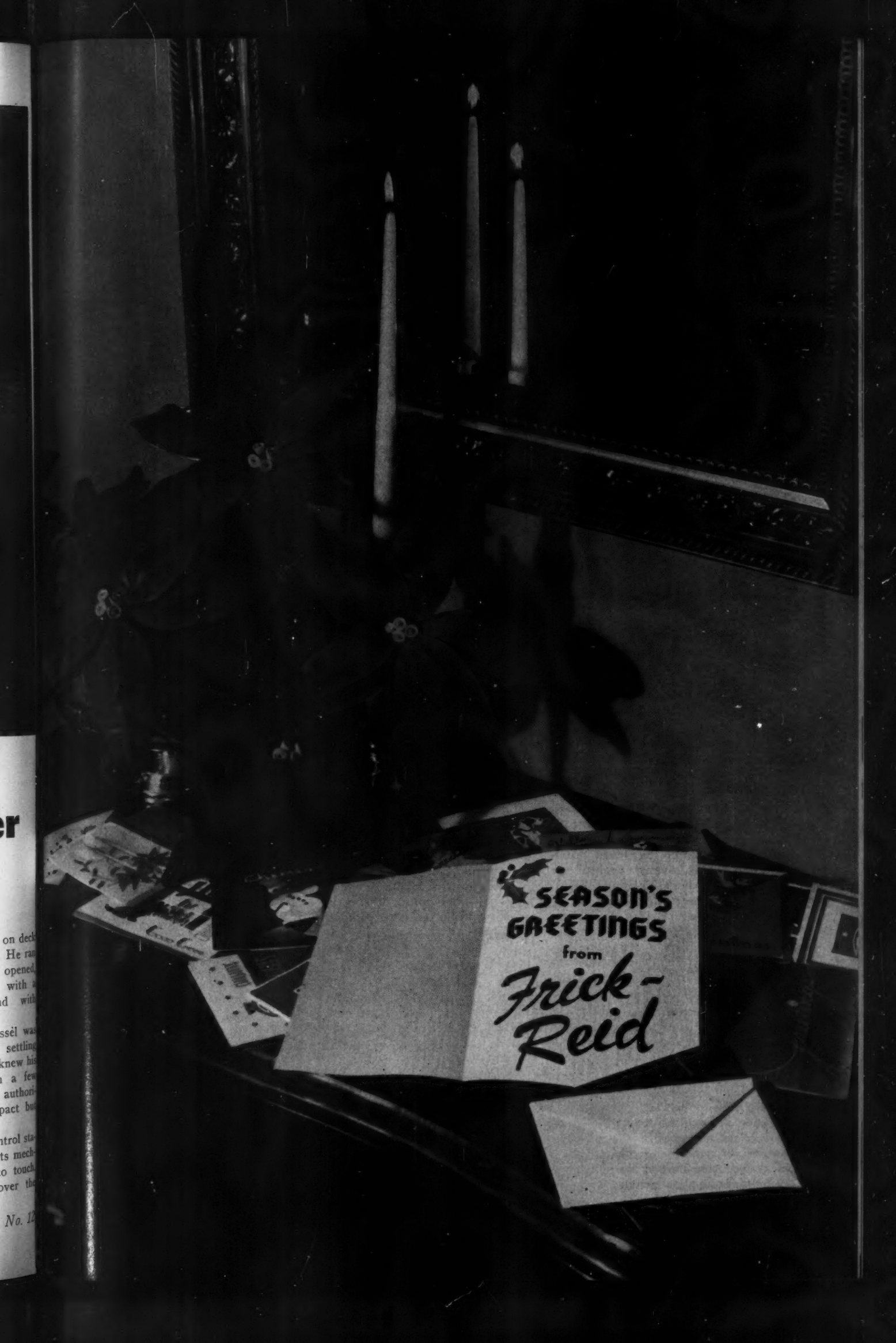
But they were wrong. The blast they heard occurred when a munitions-laden cargo vessel struck a tanker hard on the port side, almost sheering off the tanker's forepeak. The munitions ship exploded with a roar heard 50 miles away and sank like a stone. The tanker, carrying more than 107,000 barrels of assorted petroleum fuels, caught fire from stem to stern when her deck lines ruptured.

Nothing could be done for the munitions vessel or its crew. But the tanker posed a fire-fighting problem that was made to order for the Naval base at Norfolk, where firemen practiced daily on dummy ships ashore, learning how to put out just such fires as this one.

Heat on the tanker instantly was so intense that every member of the crew still alive was forced to go over the side. Every one, that is, except one. A pump man at his station deep in the bowels of the ship felt the mighty jar of the collision, sensed the ship losing its forward motion, and ran out on deck to find it a solid mass of flame. He ran at once to the valves which, if opened, would have flooded the deck with the special fire-fighting compound with which the ship was equipped.

The lights were out, the vessel was almost dead in the water and settling by the bow, but the pumpman knew his station and was there within a few seconds. (He later told naval authorities he felt the collision's impact but heard no explosion!)

When he reached the fire control station the valves and wheels of its mechanism were already too hot to touch. He followed his shipmates over the


SEASON'S
GREETINGS
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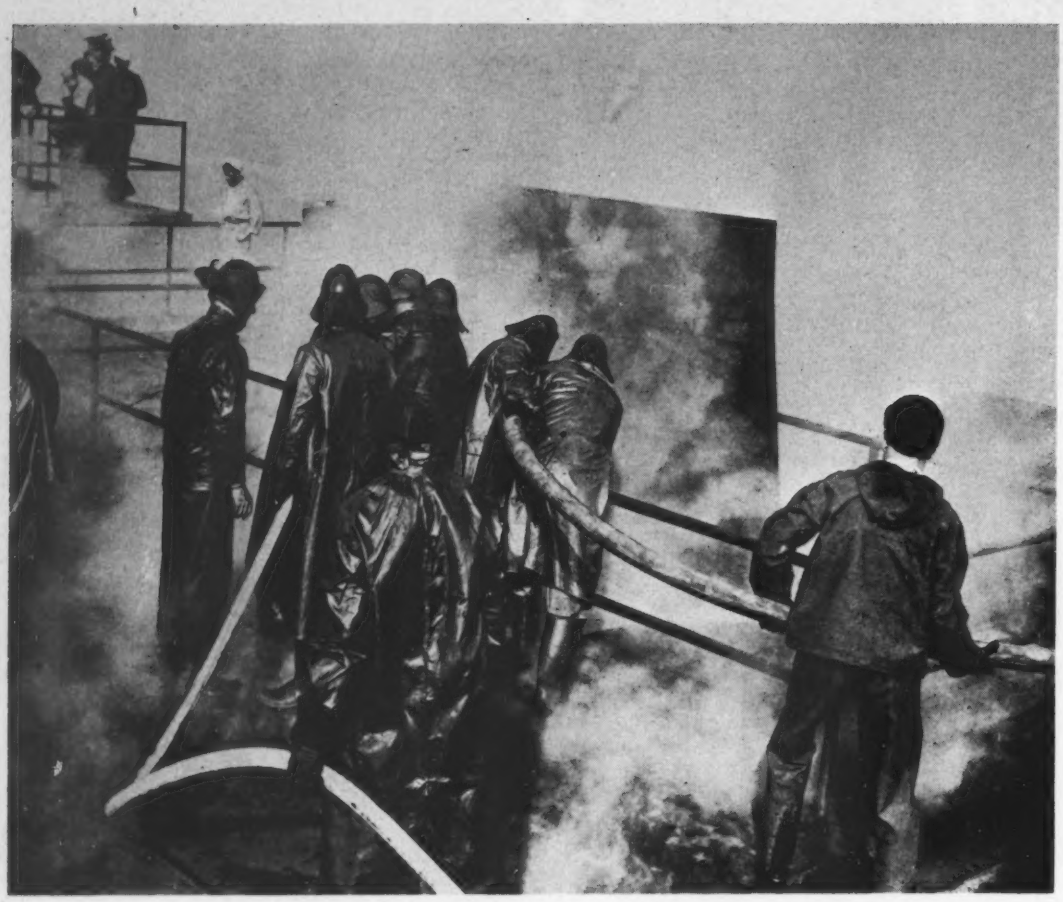


The Navy learns by creating its own fire at training school, so men can fight fire as they will find it after a submarine has struck.

side. By that time ammunition to be used in the vessel's fore and aft deck guns was exploding with terrifying regularity. No man could have stayed aboard the blazing tanker and live.

So intense was the heat that bronze fittings and gaskets melted, chain and cable gear snapped, and a spare propeller lashed to the deck and destined for delivery in some far port had its fins melted away.

Yet the Navy, through the members of its fire-fighting school at Norfolk, was able to meet this explosive situation on much better than even terms. While airplanes hovered against the chance that a submarine would be attracted to the scene, and finish off the luckless tanker with a torpedo, 10 firemen from Little Creek, Virginia, aboard a tug equipped with a 500-gallon-per-minute pump arrived. They boarded the now furiously burning tanker and jettisoned her remaining ammunition.

Before the heat drove them off the tanker, they attached a line to it, and she was towed at a speed of two knots into the wind. Eighteen hours after the collision the tanker was resting on a shoal, but all this time a steady stream of water had been played upon her.

Proper fire-fighting equipment arrived some hours after the collision, however, brought by 13 men from the Naval Operating Base at Norfolk. Their fire-fighting supplies included a special preparation—the Navy's answer to oil fire on land and sea. Made by secret formula, this greasy, sudsy substance is available in liquid or foam form. It can be installed on shipboard either above or below decks, or wherever a hazardous condition exists. It can be applied through portable pumps with a range of 75 feet in a favorable wind, and it will insulate surfaces exposed to fire but not yet aflame.

Boarding the tanker, these fire fighters in their asbestos clothing tackled each cargo tank in order, starting at the stern, applying foam blankets of great depth. Soon they had the help of 14 other firemen similarly equipped. It was not until much later that both groups of men ran out of foam.

Some hours later they received a new supply from the Norfolk fire-fighting base. But before the fire was brought under control and the vessel judged safe, more than 20 tons of the foam had been used, together with 1,000 gallons of the liquid preparation. All the water pumps on the fire control vessels had worked steadily.

Several factors made the fire especially difficult to battle with foam. The damaged cargo space on the port side forward, into which the sea sucked and surged, could not be blanketed with the foam, and the advancing and retreating water brought with it oxygen which set off new explosions in the ship's interior. To hold the foam in place, cofferdams of empty drums and, in fact, anything that would halt the flow of the foam into the sea, were erected.

No fire remained aboard the tanker by the end of the second day. The fire had burned, therefore, for 37½ hours.

Saved were 70,000 barrels of fuel, or approximately 70 percent of the tanker's cargo; much of it was high octane gasoline which would have been a distinct loss to the war effort. In addition, the tanker itself, a $3,500,000 vessel less than a year old, was salvaged, and the Navy estimates that $400,000 worth of steel will see it back in service—and soon.

As soon as the ship was cool enough to board, officials of the oil firm which owned her went aboard, and directed a crew of torchmen and welders who cut away all the damaged superstructure, ruined handrails, winches, leaning masts and other twisted gear.

Then the vessel was towed to a port, where she rests today; blistered from one end to the other, an enormous slice out of her forward port side, great sections of her superstructure cut away.

But this tanker, which for reasons of security must remain nameless, sits today a proud testimonial to the Navy's skill in fighting dangerous fires at sea aboard vessels that might disappear in an instant, with an ear-splitting roar, beneath the waves.

SAVE space and maintenance...BOTH

IN ADDITION to design and construction which enable Badger Corrugated Expansion Joints to withstand every form of distortion to which such devices are subjected, the compactness and "packless" features of these joints are of special advantage. . . . *No waste space. No packing to watch and service.*

The flexing member of the Badger Corrugated Expansion Joint is formed by a special Badger process from a *single piece of tubing.* Ends are either Van Stoned over flanges or homogeneously attached to welding end nipples. Packing is non-existent—because it is unnecessary.

Badger ALL-CURVE corrugations prevent the localizing of stresses, which is common with straight-line corrugations and "junctions." And when the corrugations are further equipped with Badger Self-Equalizing Rings, the flexing movement is progressively controlled and limited.

Badger Corrugated Expansion Joints are just the kind plant engineers want —easy to install in small space; efficient and dependable; maintenance-free; and as long-lasting as it is humanly possible to make them. *Free Bulletin* No. 100.

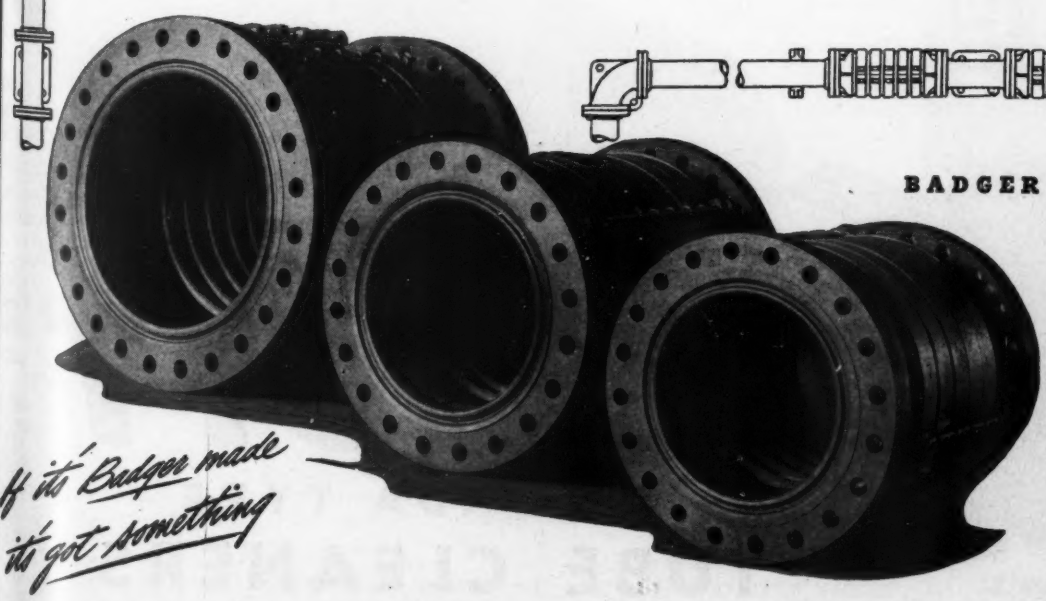
E. B. Badger & SONS CO.

75 PITTS STREET, BOSTON, MASS.

AGENTS IN PRINCIPAL CITIES

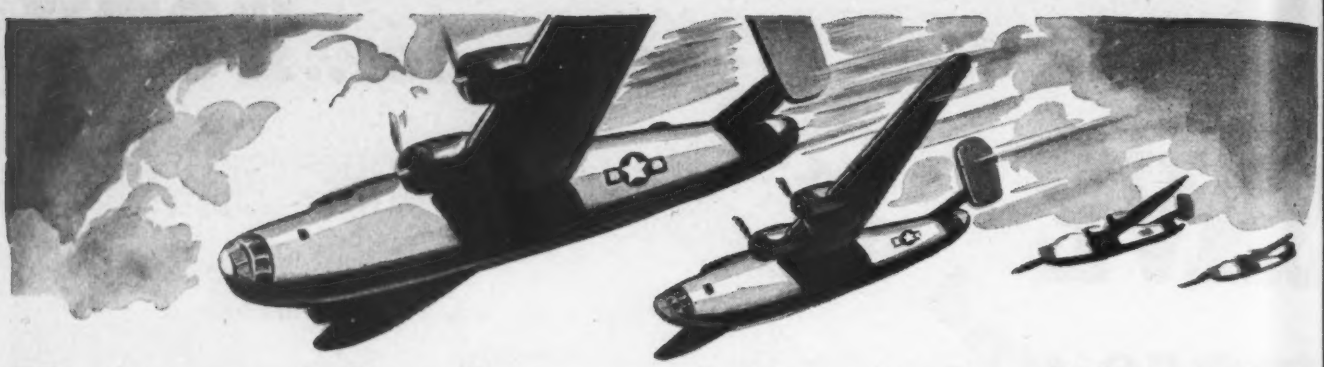
BADGER CORRUGATED EXPANSION JOINTS

PACKLESS • SELF-EQUALIZING (ILLUSTRATED) • NON-EQUALIZING



If it's Badger made it's got something

BADGER PACKLESS CORRUGATED EXPANSION JOINTS are available in all sizes—with self-equalizing rings or plain, depending on type of service required. Made of STAINLESS STEEL for the higher pressures and temperatures and for corrosion resistance. (Badger was the first to develop the application of stainless steel to corrugated expansion joints.) Also made of Copper for steam distribution.



To provide the "gas" for jobs like this

—save production time by fast still-tube cleaning

Mass bombing raids eat heavily into gasoline supply. But think of the added production represented in stepped-up tube cleaning time in the following case history:

In an important refinery the tubes in a vertical still were being cleaned at the rate of sixteen hours per tube. It was pretty tough coke, and they asked the Elliott man if he could suggest any improvement. He could, and did—the Elliott 1100 Series motor, armed with the new Elliott UD cutter head. Result (and we, too, were incredulous at first), cleaning time per tube was cut from an average of 14 hours, to 15 or 20 minutes! Savings like that make Hitler squirm.

Unless you are absolutely sure that your still down time cannot be cut, better check. Ask the Elliott man. Or write us.

ELLIOTT COMPANY
Tube Cleaner Division
SPRINGFIELD, OHIO
DISTRICT OFFICES IN PRINCIPAL CITIES

Y-214

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LAGONDA TYPE
TUBE CLEANERS

Higher Price Urged as Assurance Of New Oil Discoveries

Challenging the "defeatist" attitude recently displayed in some administration quarters, that we have reached the practical end of oil discovery possibilities in the United States, Russell B. Brown, general counsel for the Independent Petroleum Association, told the Lea Oil Subcommittee of the House December 3 that given a proper crude price there is no reason to believe that sufficient new oil cannot be discovered to carry this country for a number of years.

Brown, the first of a number of independent representatives to be heard, told the committee that the current ceiling was based on prices which had been hammered down by the major buying companies, a "mistake in judgment on their part," which the companies now recognize but which "has been frozen into the oil operations by the government."

"It is not fair to say that our domestic industry can no longer be depended upon to supply the major part of our country's petroleum requirements," he asserted. "We must first give the industry an opportunity, under conditions that are normal to its operations, to demonstrate its abilities before we turn to the alternatives that have been suggested."

The oil ceilings, he testified, are not in conformity with provisions of the price control act contemplating "fair and equitable prices that will assist in securing adequate production of necessary commodities," and "the artificial restraints now imposed are the product of administrative interposition of philosophies foreign to the intent and words of the law as passed."

Reviewing the frustrated efforts of the independents to secure consideration of their needs from the war agencies, Brown told the subcommittee that "the producer is now convinced that he must look to Congress for the action which will stimulate the field activity that must come, and come soon, if this nation is not to undergo a shortage of petroleum so great as to be demoralizing to the entire people.

"That is not a mere possibility" he insisted. "It is inevitable unless the producer gets to work soon. Already, great damage has been done. Already, much valuable time has been lost. It takes many months to obtain results from a campaign of exploration of the kind we have needed for several years."

Least Effective Way

The administration, he said, has adopted the least effective of the two ways open to it to meet the situation, by urging the industry to develop more oil while withholding the means for exploration, instead of stimulating the production of existing wells and encouraging wildcatting.

The number of wells drilled, he pointed out, is less important than the type of wildcats developed, and most of the exploration in recent years has been in the vicinity of known large fields, where there is a good chance of uncovering small pools, rather than remote from settled area as has been the practice in the past.

"Because discovery effort has failed to yield important results in the past two years, some of the prophets now assert that we have neared the end of the trail; that we shall have to rely forever upon the oil resources of foreign countries and upon substitute motor fuels from coal and oil shales," he added.

This thinking, Brown declared, was probably responsible for the development of PRC, whose description by Representative Wolverton of New Jersey as a "typical Delaware corporation," was amplified by Congressman Brown of Ohio as, because of its government basis, a "double-barreled affair."

Because much of the South American crude is heavy fuel grade, Brown said, there is a definite limit to the amount of oil which can be imported from that area for gasoline-making purposes.

"The oil resources of the United States still constitute the principal reliance of the citizens of the United States," he said. "That applies equally to private consumers and to industries and to the military program as well. Yet the attitude of certain persons in government is one of permitting the supply from our own resources to decline through lack of effort, and to rely upon the hope that somewhere in the world, somehow, the needed oil will be produced and brought to our markets. Such a program is unrealistic, shortsighted and productive of great injury to the entire economy of our people."

Brown commented that a recent article in the American Magazine under Ickes' name voices a philosophy in favor of government anticipation in foreign oil development and of government ownership of interests in private oil companies.

"The administrative agencies of our government," he concluded, "are in agreement that there now is a shortage of crude petroleum; that there is need to correct this shortage by increasing our supply.

"The only disagreement is on the method to accomplish this increase. On the one hand you have the experience of a successful industry supported by a federal agency to whom has been delegated the responsibility to insure the supply needed. On the other you have positive denial of the remedy suggested. This denial is effective to frustrate our every effort. In making this denial they recognize the need but ask for the application of some untried experiment.

"The legislative branch of our government could and should break this deadlock."

Recognizing that opposition to an increase in ceiling prices is based largely on a determination to add nothing to the profits of the major companies, Congressman Brown asked if the independents would be willing to accept a price increase covered by a provision that all of the money received from the increase, after allowance for a "fair" profit on operation of, say, six percent, should be required to be spent for exploration and development and if not so spent be recaptured by the government. The IPA counsel said he could accept the principle outlined by Brown and would be willing to cooperate in the drafting of that type of legislation.

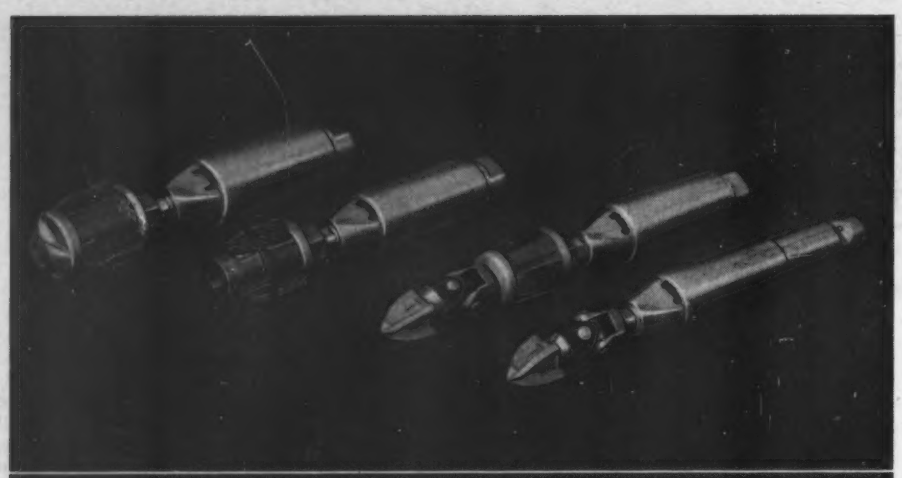
George Granger Brown Is President of AICE

George Granger Brown, chairman of the department of chemical and metallurgical engineering at the University of Michigan, was elected president of the American Institute of Chemical Engineers at its annual meeting in Pittsburgh November 15 and 16. L. W. Bass, director of the New England Industrial Research Foundation, Boston, was elected vice president.

Brown has long been active in petroleum circles, especially in natural gasoline manufacture. For 10 years he had charge of the research program of the Natural Gasoline Association of America. In 1940 he was given the Hanlon Award, an annual recognition of the most outstanding contribution in natural gasoline recovery.

Bass formerly was assistant director of Mellon Institute. Some of his current

DR. GEORGE GRANGER BROWN



PRODUCE *MORE* FOR VICTORY!
USE WILSON TUBE CLEANERS!

This is a war of *production* as well as of arms. It demands the production of guns, tanks, planes, ships, munitions *and* many petroleum products in greater quantities than ever before in our nation's history. Nothing is more essential to a speedy and complete victory than a never failing and constantly increasing supply of gasoline, lube and fuel oils, greases, etc. Therefore every *extra hour* that a still or other refinery unit can remain on stream—*every minute* of tube cleaning down-time that can be saved—means increased refinery efficiency and *greater* production of many vital petroleum products.

Wilson Tube Cleaners clean tubes *faster, better,* and *more economically* because they have *greater power, greater speed, greater strength,* and *greater all-round efficiency.* There is a Wilson Tube Cleaner, cutter head or other accessory to meet *every* refinery tube cleaning need.

Send for a copy of our 40-page catalog which fully describes the complete line of Wilson tube cleaning equipment, consult our engineering department or ask for the name of our representative nearest to you. We have representatives in all principal cities.

BACK THE ATTACK! **BUY WAR BONDS AND STAMPS!**

THOMAS C. WILSON, Inc.
PIPE AND TUBE CLEANERS EXCLUSIVELY
THE WILSON BUILDING
21-11 44TH AVE. LONG ISLAND CITY, N. Y.

activities include that of technical aide, office of chairman, National Defense Research Council, chairman of the committee on quartermaster problems of the National Research Council, and membership on the advisory board of the research and development branch, Office of Quartermaster General.

Seek Greater Output of Light Hydrocarbons

Expansion of facilities for recovery of lighter hydrocarbons from cycling and natural-gasoline plants is in prospect for 1944. Need for butanes and other choice ingredients for aviation gasoline is such that the Petroleum Administration for War is urging the industry to provide for increased output. Executives of the industry and representatives of PAW met in Dallas December 1 to consider projects that can be incorporated in the program.

Two methods will be pushed. New plants will be built and additional fractionating equipment will be provided in existing plants. Projects already approved will recover more than 20,000,000 barrels of condensate and natural gasoline each day. Average recovery of butanes and pentanes will add to the total of these materials.

Technologists of the industry as well as the government are working on projects for increasing light-hydrocarbon recovery at existing facilities. It is likely that several cooperative fractionating units will be provided. In older oil fields central fractionating plants can serve several natural gasoline plants.

Cycling plants already assured because of priority approvals include:

	Capacity in Barrels	Cost
Abercrombie-Magnolia Old Ocean, Texas (addition)	4,000	$ 1,250,000
Humble Oil & Refining Co., Katy, Texas (addition)	5,500	4,500,000
Shell Oil Company, Sheridan, Texas	6,000	2,500,000
The Texas Company, Bateman Lake, Louisiana	1,000	1,000,000
Western Gulf Oil Company, Paloma, California	2,000	2,500,000

Natural gasoline projects given approval are:

Phillips Petroleum Company, Eunice, New Mexico (addition)	500	525,000
Phillips Petroleum Company, Seminole, Texas	1,000	900,000
Warren Petroleum Company and Humble Oil & Refining Company, Hawkins, Texas	1,000	800,000
Totals	21,000	$13,975,000

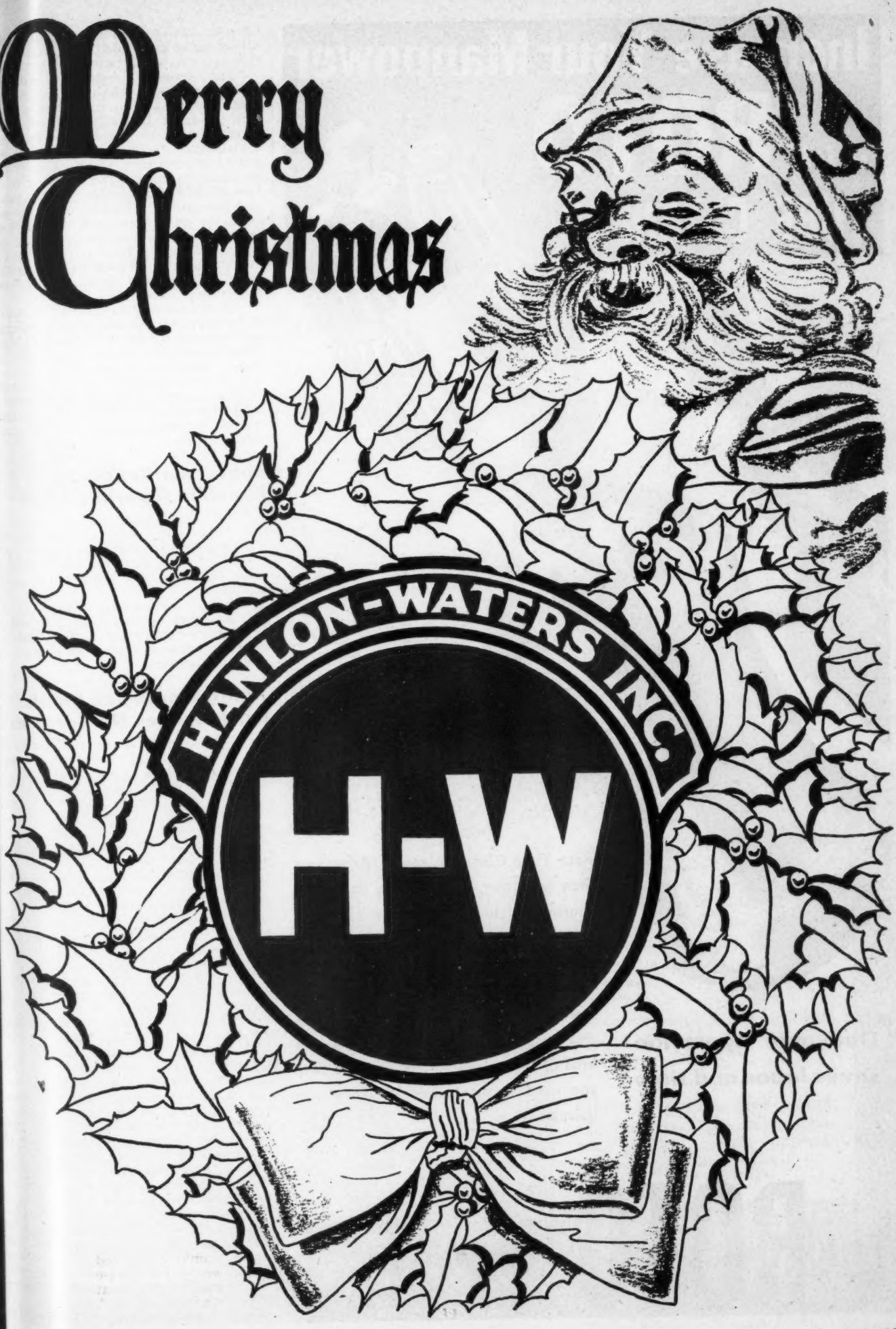
Expenditure of more than $25,000,000 during the year is indicated for cycling and natural gasoline since it is known that projects are under consideration for Chapel Hill, Carthage and McAllen in Texas and Paradise Lake, Louisiana.

Meter School to Meet In Norman, June 6-8

Resumption of the Southwestern Gas Measurement Short Course was voted by the general committee in November. The meeting will be at the University of Oklahoma, Norman, June 6, 7 and 8. The announcement was:

"The omission of the course in 1943 was keenly felt by persons engaged in gas measurement and related work. This was especially true of new personnel who did not have an opportunity to receive the specialized training as given in an intensified form during the Southwestern Gas Measurement Short

Merry Christmas



Increase Your Manpower with ROTO TUBE CLEANERS

One-man operation saves labor and time

Roto Tube Cleaners, equipped for one-man operation, are relieving the acute shortage of help in hundreds of plants throughout the country. An air valve on the motor permits the operator himself to control the air, eliminating the need for a helper, and saving time-loss due to signalling. Roto offers you the kind of tube cleaning performance that you need to meet today's critical requirements.

The ROTO Company
145 Sussex Ave., Newark, N. J.

Course. Older workers also missed the schooling opportunities presented through this educational project.

"The general committee instructed Earl Kightlinger, chairman of the program committee, to formulate a tentative program to be presented to the group at a meeting which will be held in Oklahoma City in January. It was suggested the morning sessions be devoted to elementary gas laws and the fundamentals of orifice meters, positive meters and regulation. The afternoon sessions, as in the past years, will deal with the fundamentals of regulation giving special attention to round table discussions and the opportunity for field men to receive help on any particular problems they might have.

Various manufacturers will be invited to have exhibits during the school which will be used for the most part as visual aides to clarify material covered in lectures. Members of the armed services who are charged with the responsibility of gas measurement and distribution at their respective stations, will be issued special invitations to attend the course this year.

Robertson Retires as Republic Superintendent

C. E. Robertson, superintendent of the Texas City plant of Republic Oil Refining Company, has retired.

C. C. Evans, assistant superintendent since 1933, has been promoted to superintendent.

Other promotions are: Russell Homsten, assistant superintendent in charge of operations; Louis Keller, assistant superintendent in charge of engineering and maintenance.

Jones Would Sell Plants But Proposes No Bargains

Development of an over-all policy for the disposition of government-owned war plants which, among other things, would prevent the establishment of monopolies, was urged before a House committee November 30 by Secretary of Commerce Jesse Jones, under whose administration whole new industries have been built up.

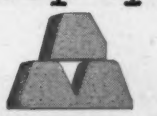
The disposal of huge surpluses, not only of manufacturing plants but of Army and Navy stores and real estate now used for training and other purposes, Jones said, is a major problem of post-war conversion to which consideration should be given now.

Jones reported that Reconstruction Finance Corporation is now engaged in a survey of the plants financed by Defense Plant Corporation, looking toward their disposal to private industry.

The government today, he disclosed, is a big factor in many lines of production, controlling approximately 55 percent of the national output of aluminum, 8 to 9 percent of the steel producing capacity, about 90 percent of the aircraft production facilities, and practically all of the synthetic-rubber production.

As a result of the administration's rubber program, he told the committee, the United States now could produce "at least a third more" synthetic rubber than the pre-war consumption of natural rubber, and added that there are indications that synthetic could be produced just as cheaply as we could purchase natural crude at pre-war prices and that it would be just as good.

Jones warned that those interested in

A steam turbine needs a big frame to develop Elephant Power . But if you need only Horsepower, a **COPPUS** Steam Turbine saves money and metal . Six sizes from 150 Horsepower down to fractional. Each smaller size has smaller frame requires less metal and is priced less . Each is a COPPUS Blue Ribbon Turbine so you get top quality while saving money and metal  .

COPPUS TURBINES

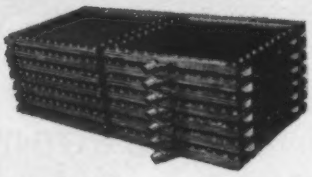
Save Metal in Wartime — Will Save You Money in Peacetime

Like all Coppus "Blue Ribbon" Products (blowers, ventilators, gas burners, etc.), the small H.P. steam turbine is a precision-made product . . . controlled by Johansson size blocks . . . and every turbine is dynamometer-tested before shipment. 85% of all orders since 1937 have been repeat orders.

Write for Bulletin 135-9

COPPUS ENGINEERING CORPORATION
422 Park Ave., Worcester, Mass.
Sales Offices in THOMAS' REGISTER.
Other "Blue Ribbon" Products in REFINERY CATALOG.

"MULTI" means MANY



All stainless, pressure filter leaves

HERE at Multi-Metal, many Wire and Filter Cloth products have been fabricated for the country's leading refiners, using a great variety of metals.

Now Multi-Metal's increased fabrication facilities are producing a still greater variety of products to aid the war effort.

Consult us today on your problems involving Wire and Filter Cloth assemblies or sheet metal fabrications.

Welding "Multileaves"

25' diameter "Singledisc" one homogeneous fabric.

Welding pipe line strainers

MULTI-METAL WIRE CLOTH COMPANY INCORPORATED
1356 GARRISON AVE., BRONX BORO, N. Y.

WIRE CLOTH
FILTER CLOTH
ALL MESHES
ALL METALS

"Best pump buy we ever made"

...from a letter by a chemical process plant executive to Taber.

Pump illustrated is used extensively for handling Oleum, Concentrated Sulphuric Acid, Mixed Acids, etc., because:

1. Liquids handled do not come in contact with pump stuffing box.
2. Repacking interruptions reduced to a minimum.
3. To compensate for non-lubricating properties of liquid or other chemical solutions pumped, larger bearings are used.
4. Damaging vibration is prevented by larger shaft diameters.

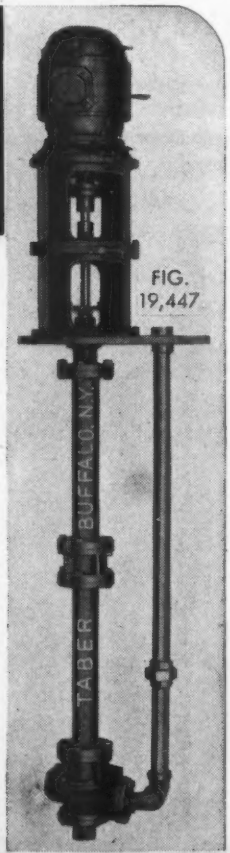


FIG. 19,447

For complete information write for BULLETIN V-837

AD No. 5414

TABER Pump Co. 277 ELM STREET BUFFALO, N. Y. *Established 1859*

the acquisition of plant facilities or surplus stocks should not expect "too many bargains," and indicated that, so far as the facilities under his control are concerned, the selling price will have some relation to the cost of production.

The secretary told the committee that RFC subsidiaries are in a position to sell plants and strategic materials but, while he said the latter are being sold every day, he did not disclose whether any negotiations have been entered into for the transfer of manufacturing facilities.

Baltimore Catalytic Plant Is Sixth in SONJ Family

Dedication of the fluid catalytic unit and other equipment at the Baltimore plant of Standard Oil Company of New Jersey November 30 and December 1 gave the company and affiliates six complete refining plants for the making of 100-octane aviation gasoline. The plant is 66 years old and the modernization program brings it into line at a cost of $14,000,000.

November 30 a program on the theme "Petroleum in War and in Peace" under auspices of the Maryland Academy of Sciences preceded the dedication December 1. On the program Ralph W. Gallagher, president of Standard Oil Company (New Jersey), spoke on "Democracy, Petroleum and Progress." Robert P. Russell, vice president of Standard Oil Development Company, told of engineering and construction details of the new plant under the title, "Genesis of a Giant." "Miracles for the Common Man" was the subject of Dr. Per K. Frolich, director of Esso Laboratories, Chemical Division, and president of the American Chemical Society.

Dr. S. Karrer presided. Roy B. White, chairman of the board of Maryland Academy of Sciences, gave the opening remarks and Chester F. Smith, president of Standard Oil Company of New Jersey, spoke.

The next day Smith presided at the dedication program at the plant, where the principal speaker was Senator Ralph O. Brewster of Maine, one of the five senators who recently reported on world travels. Other speakers were Governor Herbert R. O'Connor of Maryland and Mayor Theodore R. McKeldin of Baltimore.

At noon that day R. T. Haslam, director of Standard Oil Company (New Jersey), addressed the Baltimore Advertising Club.

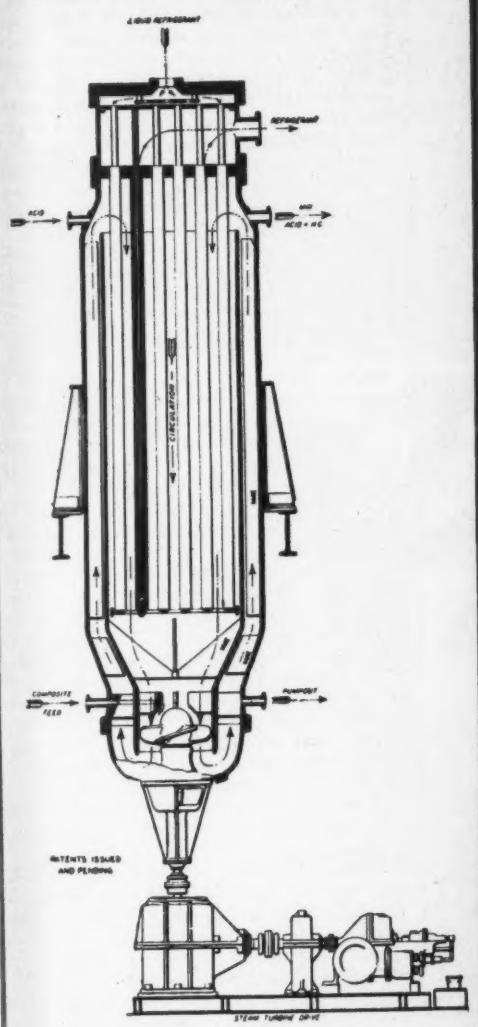
Synthetic Rubber to Win On Its Merits

Superior qualities of synthetic rubber are such that the product will continue to hold its place in industry in the opinion of officials of Hycar Chemical Company, Akron, whose statement was issued in response to so many predictions that the new industry will be abandoned at the end of the war.

The statement pointed to this one factor, the superiority of synthetic rubber over the natural product established in innumerable industrial applications before the war. "Lack of knowledge of these facts," the statement pointed out, "is the cause for many ill-advised opinions, some of them by persons in positions of considerable public prominence

"The real issue is whether the synthetic has sufficient merit of its own to justify its continued production. This

STRATCO ALKYLATE



STRATCO ALKYLATION CONTACTOR

Higher Yield
Higher Octane

Result:

MORE FIGHTING FUEL

STRATFORD ENGINEERING CORPORATION

PETROLEUM REFINING ENGINEERS

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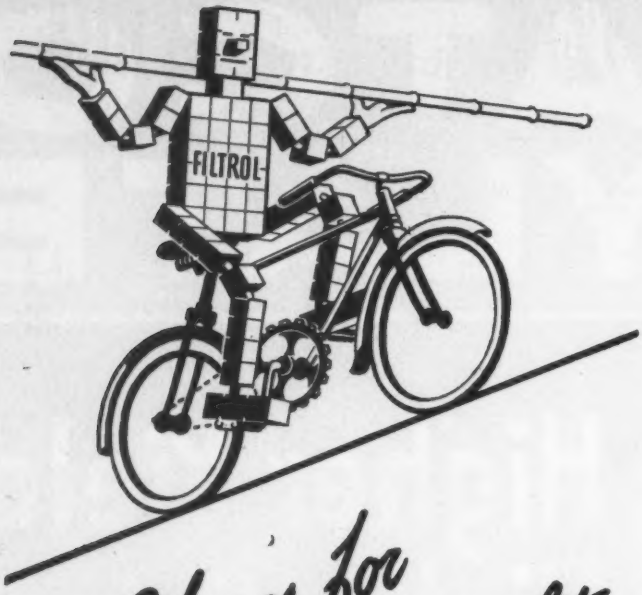


Yours for Balanced Quality

"MONTY"

*Montmorillonite structure

Continuous maintenance of huge quantities of *quality* specification lube oil imposes a double burden on the modern refiner . . . the need for more and better production was never greater. And with new equipment hard to get, the problem is intensified. But there is a solution . . . a solution that will enable you to produce more and better specification lubricants with less equipment and at lower cost.

The Filtrol Engineers and "Monty" (Super Filtrol), their activated agent, are the solution. These engineers will study your plant and processes, and suggest ways and means of getting more production from present equipment. When you say the word, "Monty" will be put to work . . . *he* will produce *balanced quality* and lots of it! Filtrol Corporation, 634 S. Spring St., Los Angeles, Calif. Plants: Vernon, California, and Jackson, Mississippi. (5)

Super FILTROL

THE ACTIVATED AGENT SPEEDS PRODUCTION — CONSERVES MATERIALS

is the only consideration which can have a bearing on the matter."

"The man-made rubber is performing in services today which even prior to the war were far out of reach of the natural product. As a result," the statement says, "an entirely new field of service for resilient materials has been created by synthetics."

Resistance to oil and gasoline is said to be one of the many outstanding superiorities of the synthetics over the natural product. This advantage, it is stated, assures a longer service life.

Not only is longer service life assured, but the efficiency of its operation is reported increased. In the presence of oil or gasoline, natural rubber has a tendency to swell and disintegrate whereas the effect on the oil-resistant synthetics is said to be imperceptible. The importance of this diference will be apparent, the statement says, in any oil or gasoline application where retention of design and strength requirements are vital.

Superior resistance to abrasion is another property which may be obtained with synthetics, the statement says, and this will further assure the material's future. Field performance studies, as well as laboratory abrasion tests, are said to prove without question this property of some synthetics. Such tests, according to the company, show that several Hycar synthetic rubbers have approximately 50 percent greater resistance to abrasion than natural rubber.

The matter of resistance to effects of heat, the company points out, is also significant and should be included in any appraisal intended to judge the value of important industrial materials.

"Heat service tests leave no doubt as to the superiority of certain synthetics. Natural rubber is considerably softened at 212 degrees Fahrenheit (the boiling point of water), while the Hycar oil-resistant synthetics show little change. When heated for a few hours at 300 degrees Fahrenheit, natural rubber becomes unserviceable, losing all of its elastic properties and tensile strength. Under the same test, the Hycar synthetic is practically unaffected and can withstand these temperatures for several days without serious impairment of properties.

"The foregoing established superiorities which can be achieved with synthetics, not to mention others which could readily be cited, leave no question as to whether or not we shall have synthetic rubber after the war.

"The significance and possibilities of the synthetics have only begun now to be realized. The many applications for synthetic rubber in which natural rubber was never even considered are only a clue to the future. Many new types of synthetics are now being developed in the laboratory which herald an entirely new field of usefulness for these resilient materials.

"Any individual who regards synthetic rubber as no more than a temporary substitute for the natural product is speaking without knowledge of the facts. It is only ill-advised opinions which will throw into the discard a material which has so many striking advantages."

Chester A. Fulton Is President of AIMME

Chester Alan Fulton, president of Southern Phosphate Corporation, Baltimore, has been elected president of the American Institute of Mining and

For the PRIMARY ENGINEERING
OF YOUR POST-WAR PRODUCTS PLANT
Plus
DEPENDABLE MACHINERY
YOU NEED FOR ITS OPERATION—
COME TO PATTERSON
UNIPOWER
PATTERSON
● Design and construction of plants for new petroleum products is a Patterson service—linked with supplying the process machinery which sets the industry's standards!
President
THE PATTERSON FOUNDRY & MACHINE CO.
EAST LIVERPOOL, OHIO, U. S. A.

Make Good Piping Better

with

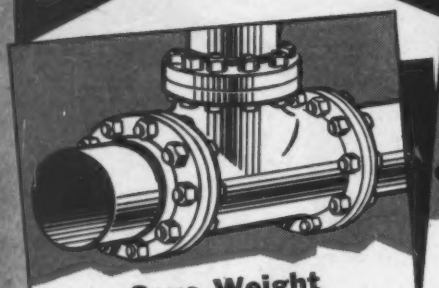
WELDOLETS · THREDOLETS

3 Types Meet Every Need

WeldOlets for butt welded branch connections.

ThredOlets for screwed branch connections.

Socket-End WeldOlets for socket-type welded branch connections.

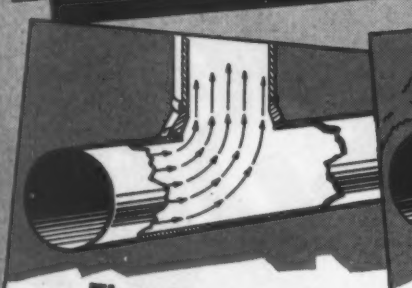


Save Weight

WeldOlets, ThredOlets keep the weight of any piping system to a minimum. Fewer flanged joints mean less possibility of leaks.

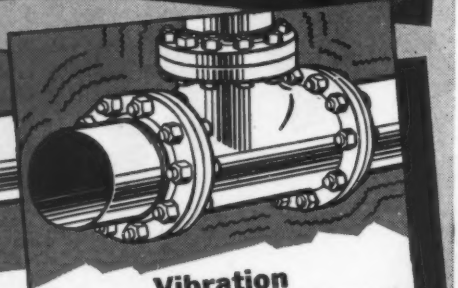
Gaskets, Bolts, Nuts

Maintenance eliminated when WeldOlets, ThredOlets are used—no need to change gaskets, tighten nuts and bolts.



Flow Improved

Funnel-shaped intake aperture of WeldOlets, ThredOlets improve flow conditions, reduces turbulence and friction.



Vibration

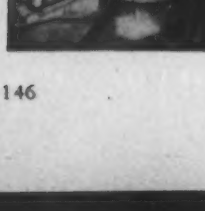
Due to light weight and improved flow conditions, vibrational stresses are reduced, possibility of leaks eliminated when WeldOlets, ThredOlets are used.

WeldOlets, ThredOlets and Socket-End WeldOlets are suitable for all commonly used pressures and temperatures in every type of piping system. They are installed either before or after erection of the main line—and always with ease and economy. They are equally well adapted to pre-fabricated or "on-the-job" assemblies. Stocked for all standard pipe sizes up to 12" in size-to-size and reducing sizes—and can be supplied on special order for pipe up to 24". Stock fittings are drop forged steel, but to meet special conditions will be supplied in Monel, Everdur, Toncan Iron, wrought iron, etc.

Bulletin WT31 gives detailed information about all the advantages of WeldOlets, ThredOlets and Socket-End WeldOlets. Write for your copy today.

Forged Fittings Division

Bonney Forge & Tool Works, Allentown, Pa.



ARMY E NAVY

Star Awarded July 10, 1943

WELDOLETS · THREDOLETS

TRADE MARKS · REG. U.S. PAT. OFF.

Welded Outlets for Every Piping System

Metallurgical Engineers. The two vice presidents are John Livermore Christie, Handy and Harmon, Bridgeport, Connecticut, and Robert Van Pelt, Jr., Museum of Science and Industry, Chicago. Among the directors are Wallace E. Pratt, vice president of Standard Oil Company (New Jersey) and John R. Suman, vice president of Humble Oil & Refining Company, Houston.

The election was by letter ballot to 12,000 members.

Gaston F. DuBois Gets Perkin Medal

Gaston F. DuBois, vice president of Monsanto Chemical Company, St. Louis, was presented with the Perkin Medal through the American Section of the Society of the Chemical Industry December 7 in New York. He is the thirty-eighth member of the society to receive this award, which was established in 1906 in honor of Sir William Perkin, the English chemist who discovered the dyestuff "mauve" in 1856, thus laying the foundation for the coal-tar chemical industry.

DuBois is a native of Switzerland, who came to the United States in 1904 after schooling in his native country and in Dresden. He joined the staff of Monsanto Chemical Company shortly after reaching this country and has contributed to practically every technical development of the company and its subsidiaries. He became vice president and technical director in 1920. From 1930 to 1939 he was in charge of the development and research program. In 1939 he became a member of the executive committee which governs the operating policies of the company.

Recently he has devoted much of his activity to the development of processes for making styrene.

Foster Dee Snell, Brooklyn, chairman of the American Section, presided at the dinner in New York. The presentation was made by Professor Marston T. Bogert, Columbia University. Francis J. Curtis, vice president of Monsanto Chemical Company, read a paper on the life of DuBois, while Dr. Charles Allen Thomas, director of the Monsanto research department, recounted the professional accomplishments of the recipient.

Two New Committees Study Instrument Piping

Two new special subcommittees are being appointed to function under the procedure of the Sectional Committee on Code for Pressure Piping B31 of the American Society of Mechanical Engineers, as a result of recommendations. One of the subcommittees will formulate requirements for instrument piping, the other will develop quality factors for castings and working stresses for steel castings, forging, plate, and bars, all for inclusion in the American Standard Code for Pressure Piping, ASA B31.1-1942.

It has been recognized for some time that present code requirements and standards for instrument piping are not sufficiently complete to provide adequate assurance of the safety of such piping systems. The new subcommittee to handle this assignment will consist of members of Sectional Committee B31 selected from the subcommittees that developed each section of the code representing the several types of piping,

Scovill Tube News

SCOVILL MANUFACTURING COMPANY, Waterbury, Conn.

Factors Affecting War-Time Efficiency of Condenser and Heat Exchanger Tubes

The widespread use of copper and copper alloys in heat exchanging equipment is due in some measure to the many favorable physical properties of these materials, i.e., their ductility, toughness, strength, high thermal conductivity, etc., over a wide range of temperatures and pressures. The excellent corrosion-resistance of the copper alloys under most operating conditions, however, is of major importance in this application. The ability of copper and its alloys to withstand the corrosive action of such media as fresh and salt waters, sewage, hydrogen sulphide, acids, alkalis, etc., is of a high order and has established their value in tube form in contact with corrosive media. They have proved their dependability and economy under such conditions as well as under wide fluctuations of temperature, pressure and velocity of the circulating media.

Serious corrosion of condenser and heat exchanger tube does occur, however, particularly when corrosive conditions are admittedly very severe and such corrosion may result in considerable expense, costly delays and shut-down of equipment. In many cases, no improvement in tube life can be expected under existing conditions; in other cases, however, it has been possible to reduce or retard corrosion materially and obtain improved tube performance either by slight changes in operating conditions, by attention to certain operating details or by a change from one tube alloy to another which is more corrosion-resistant to the particular service conditions. For this reason, an appreciation of the factors which contribute to corrosion of tube materials is often of value to a better understanding of corrosion problems; this knowledge, in turn may be used to advantage in combatting such problems and in improving tube life. The subject is considered of sufficient importance to tube users to warrant discussion of the more important matters pertaining to corrosion problems.

"Service in Manuals" Designed for Scovill Customers Now Freely Available to All War-time Tube Users

The "service in manuals" begun by Scovill years ago to assist customers in choice of alloys to fit specific corrosion and installation conditions, is now proving useful to many war-time firms faced with increasing need to conserve scarce tube metal. You may find in Scovill's "Condenser Tube Booklet" just the information you need — diagrams, formulae, lists of alloys — to make your condenser tubes serve you better and longer. Write Scovill Manufacturing Company, 17 Mill Street, Waterbury, Conn.

Factors Affecting Tube Life

The service life of condenser and heat exchanger tubes is governed by the following major influences:

1. the composition of the alloy
2. the workmanship and quality of the tubes
3. the conditions of service of the tubes

The most satisfactory tube service and tube performance in a heat exchanger unit is obtained only after a careful consideration of these factors.

The Composition of the Alloy

The nonferrous alloys for heat exchanger service may be grouped into three broad classifications, as follows:

(a) Copper, Phosphorized Copper and Arsenical Copper

(b) Brasses or Copper Zinc alloys, usually containing small percentages of other metals such as Tin, Aluminum, Nickel, Iron, Lead, etc.

(c) Copper Nickel alloys, containing Copper, Nickel and, in some cases, minor amounts of other elements such as Tin, Iron, Manganese, Zinc, etc.

Scovill offers a complete range of tube alloys.

Muntz
Admiralty
Phosphorized Admiralty
Red Brass
Deoxidized Copper
Arsenical Copper
Aluminum Brass
70-30 Copper-Nickel
80-20 Copper-Nickel

Each of these has special characteristics which make it particularly suitable for use under certain conditions.

Scovill can place at your disposal the advice and consultation of men with years of experience in practical tube problems.

A Scovill tube material or method of installation may be of aid to you in obtaining longer tube life.

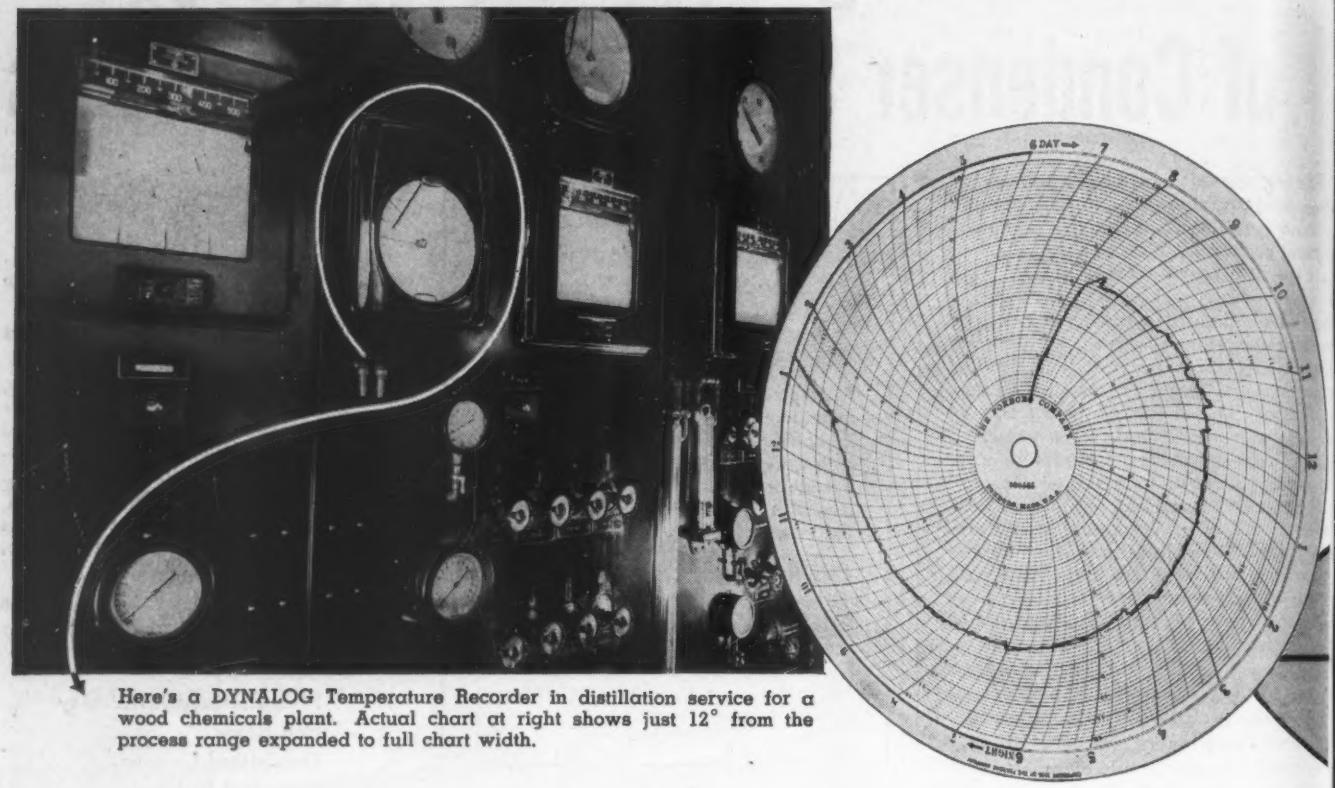
Scovill
MANUFACTURING COMPANY
WATERBURY, CONN.

SCOVILL CONDENSER TUBES

ONE PRODUCT... THREE SERVICES

Service in Manuals... Service in Metals... Service in Men

On the Record



Here's a DYNALOG Temperature Recorder in distillation service for a wood chemicals plant. Actual chart at right shows just 12° from the process range expanded to full chart width.

Foxboro engineers blaze the way to electronic sensitivity in instruments!

Today, a leading wood chemicals plant is obtaining batch distillation temperature records that can be read to 1/10°C.! This high sensitivity and accuracy means extra production – increased output of the desired cut. It is a production and economic achievement brought about by Foxboro's Electronic Dynalog Instruments.

Yet, this is only one example of the "milestones" Foxboro has established in electronic instrumentation.

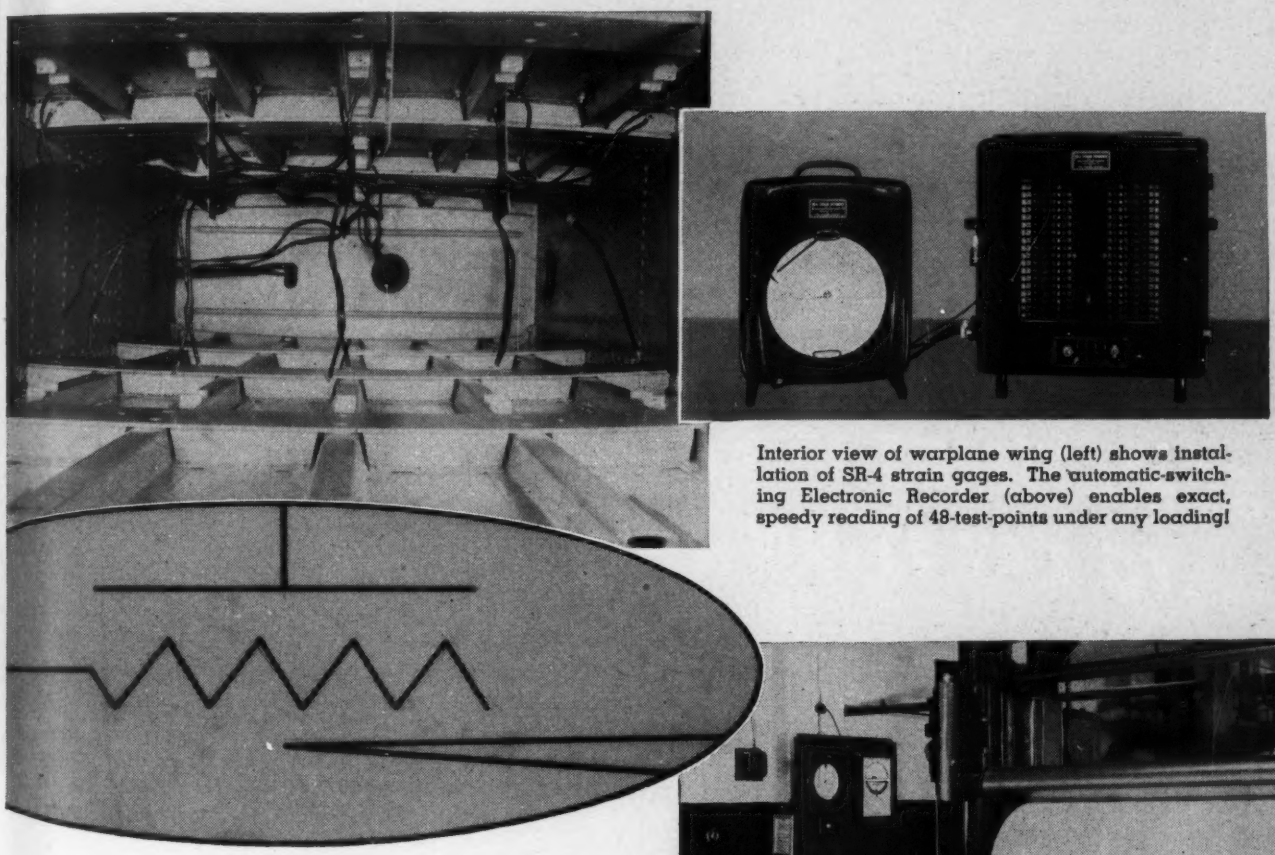
Pre-War and Wartime Developments

For more than eight years, Foxboro Verigraph Electronic Instruments have been widely used in rubber and paper industries. In meteorological service, a Foxboro Electronic Temperature Recorder has performed outstandingly for three years. And other electronic instruments by Foxboro are now enabling unique speed and accuracy in stress analysis of war planes.

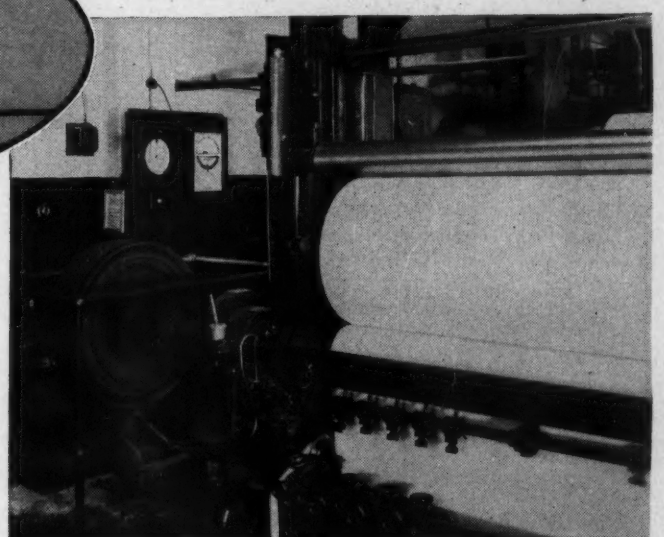
DYNALOG

Electronic Measurement and Control

...New Degrees of Sensitivity in measuring process variables!



Interior view of warplane wing (left) shows installation of SR-4 strain gages. The automatic-switching Electronic Recorder (above) enables exact, speedy reading of 48-test-points under any loading!



Typical installation of Verigraph Recorder in paper mill. These electronic instruments continuously measure moisture of moving sheets. Sensitive to changes as small as 1/10 of 1%!

Important Future Implications

Today's production of these instruments is focused on war applications. *Tomorrow, the same advanced sensitivity will be available* to all industry in Foxboro DYNALOG Instruments. Difficult measurement and control problems will be vastly simplified. In some industrial operations, DYNALOG Instruments will provide the first practical instrumentation ever developed! The Foxboro Company, 74 Neponset Avenue, Foxboro, Massachusetts, U. S. A. Branches in principal cities.

by FOXBORO

REG. U. S. PAT. OFF.

Use B-H WEATHERSEAL to Protect Exposed Insulation

Cover all insulation exposed to infiltration of water or moisture with B-H Weatherseal. This Baldwin-Hill product is an emulsified, asphalt compound furnished ready-mixed in plastic form. By reason of its exceptionally high coverage and low percentage of shrinkage, the per square foot cost is low. One hundred pounds will cover 55 square feet of surface ¼ inch thick. After drying, dehydration reduces the thickness to ⅛ inch, giving a smooth, complete seal over the entire area. You simply trowel it on. Stays permanently black—no fading or spotting. Send for generous sample of B-H Weatherseal and see for yourself how easily and thoroughly it works.

BALDWIN-HILL CO.

567 KLAGG AVE. • TRENTON 2, N. J.

NEW YORK, N. Y. • CHICAGO, ILL. • HUNTINGTON, IND. • KALAMAZOO, MICH.

together with representatives of interested manufacturers.

The second subcommittee is being formed in accordance with a recommendation made by the recently appointed Joint Conference Committee on Piping Codes and Standards, and endorsed by the subcommittee on Scope and Intent. This subcommittee's assignment will consist of two parts: (1) the formulation of working stresses for steel castings, forgings, plate, and bars for use in designing special fittings, which are not intended for application, however, to existing standard designs; (2) the development of rules for casting quality factors which will be applicable only to design of special castings.

Both of these subcommittees will be asked to develop their recommendations in the form of rules and tables similar to like data contained in the ASME Boiler Construction Code.

Walter Friedmann Has Sixty-fifth Birthday

Dr. Walter Friedmann, who has been living as a refugee in Mexico City for the past six years, celebrated his sixty-fifth birthday there November 26.

He is a pioneer in fundamental research in organic chemistry and has published 30 papers dealing with problems of petroleum refining. He is credited with being first to establish the isomerization reaction of hydrocarbons under heat and pressure.

Besides his scientific work he was active in the development of the Edeleanu process as well as in the hydrogenation of coal as well as in the application of activated carbon in the natural gas industry.

Two of his recent contributions added materially to the limited published information on the chemistry of sulphur and hydrocarbon reactions and were published in the October, 1941, and the January, 1943, issues of PETROLEUM REFINER.

Union Oil Company Buys Montana Properties

Through a transaction with American Power & Light Company, Union Oil Company of California has acquired producing and refining properties of Glacier Production Company, Cutbank, Montana. A refining plant of 4500 barrels daily capacity and a natural gasoline plant are among the properties to be transferred when final approval is had from governmental agencies.

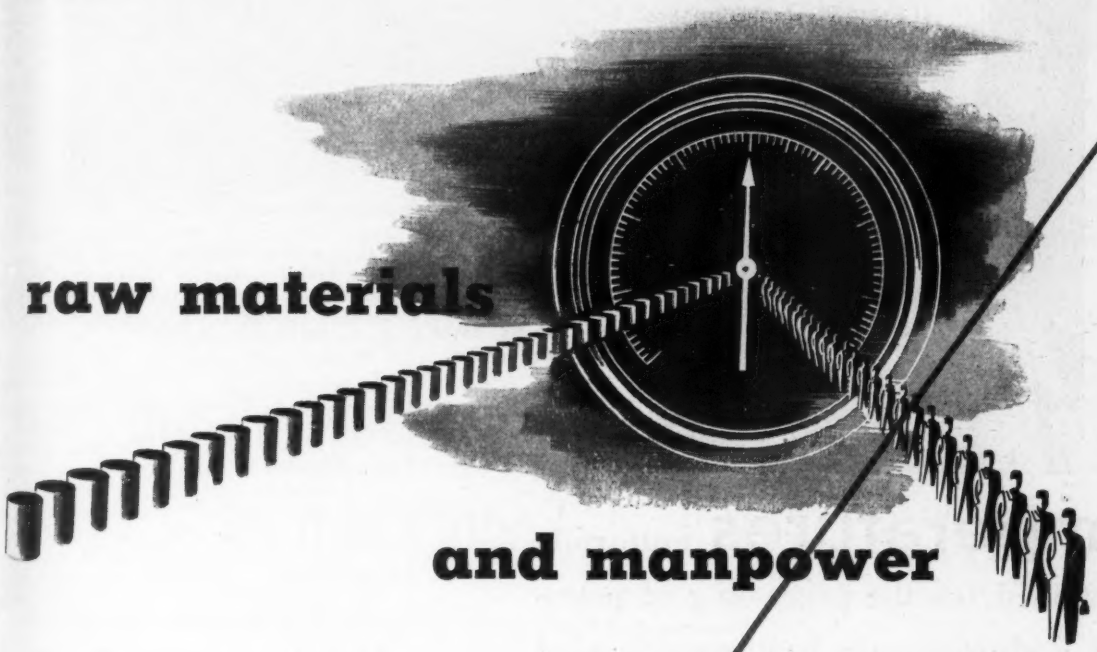
Production properties as well as sales outlets are included. The area is one in which Union Oil Company previously has not operated.

Officials Urge Speed On 100-Octane Plants

Speeding up of PAW's 100-octane refinery construction has been urged by the War and Navy Departments, and copies of letters written by Secretaries Stimson and Knox have been forwarded by Ickes to regional labor representatives of the War Production Board, War Manpower Commission, ration boards, Selective Service and housing authorities, and oil refiners and contractors building the plants, with a plea to throw all possible efforts back of the program.

Forty plants are to be completed during the next four months and 22 more built next year. Thirty-two already have been completed, but the program for

Take the pressure off



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If your plant uses a Dowtherm System, you already know the facts of this report. Manufacturers tell us that by utilizing Dowtherm—the high temperature, low pressure, heat transfer medium—operating efficiency increases materially.

Here are the major points of interest to you:

- Through Dowtherm, high pressures can be avoided in the 400-700° F. range, effecting savings in structural materials.
- Dowtherm makes possible a clean, modern system —providing vastly improved working conditions in many types of plants—saving precious man-hours.
- Dowtherm prevents severe, localized overheating —assures a uniformity of product and maximum use of raw materials.

These are a few of the many Dowtherm advantages. Based on actual service records, we can tell you that a Dowtherm installation will pay you well—now and in the future. If you are not already acquainted with this system, why not write to us for further information? Address Dowtherm Division.

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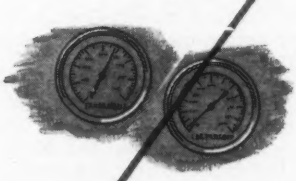

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THE HIGH TEMPERATURE, LOW PRESSURE, HEAT TRANSFER MEDIUM

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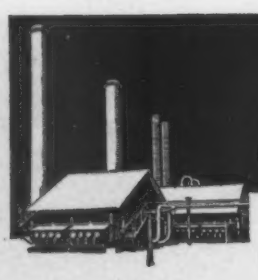
CHEMICALS INDISPENSABLE TO INDUSTRY AND VICTORY

"The life and soul of science is its practical application."
—Lord Kelvin

1839-1903
Josiah Willard Gibbs was the first physicist to apply the second law of thermodynamics to the exhaustive discussion of the relation between chemical, electrical and thermal energy and capacity for external work.

Gibbs' "Graphical Methods" in the Thermodynamics of Fluids won him fame. In 1901 he was awarded the Copley medal of the Royal Society of London.

Temperatures uniformly maintained for the processing of petroleum products require heaters engineered for a wide variety of conditions and products. Alcorn pioneered in the design and construction of heaters for processing every type and grade of oil products. This 19 year successful experience is available to you for the dependable, economical solution of any heating problem to meet existing conditions or new conditions which may result from the constantly changing technique of the industry.



ALCORN
Combustion Company
SCHAFF BUILDING, PHILADELPHIA
Los Angeles • Houston • San Francisco

some time has been suffering from labor difficulties which have made it difficult to keep to schedule.

In his letter, Knox declared that continued and accelerated operation of Naval aircraft is dependent upon increased supplies of aviation fuel, while Stimson asserted that the gasoline problem is one of the most serious matters confronting the Air Force.

Wilson Promoted to PAW Transportation Director

George A. Wilson has been appointed director of the transportation division of the Petroleum Administration for War. He succeeds J. R. Parten, who resigned to return to private business. Wilson, who is with Standard Oil Company of Louisiana, has been in the transportation division for the past 20 months.

Prior to joining Standard Oil Company of Louisiana Wilson had been engaged in private law practice as a specialist and consultant on oil and gas, in New Orleans, and in 1940 was appointed general counsel to the Louisiana Conservation Commission and the State Department of Minerals.

Parten will return to his civilian job of president of Woodley Petroleum Company of Houston, and chairman of Premier Oil Refining Company of Longview, Texas. Parten went to Washington in August, 1941, as a member of tanker coordinating board. He became head of PAW's transportation division in April, 1942. Under Parten's direction the vast network of pipe lines now being completed was developed and constructed to provide the East with oil formerly received by tanker.

Abandonment of Canol Project Urged by Poulson

Repercussions of the Truman committee investigation of the Canol project were heard in the House of Representatives last week when members from the northwestern states protested the failure to explore the Alaskan reserves and recommended that the Army turn its oil activities over to the Navy.

The matter was brought up by Representative Norris Poulson of California, who declared that responsibility for the whole project lay with Lieutenant General Brehon Somervell and not on his subordinates and held the Navy partly to blame because of its failure to develop the Alaskan reserves.

Poulson urged that "we salvage from this great mistake as much as possible and turn our efforts toward something constructive, the development in American territory of an oil reserve which leading oil experts recognize has a far better geological setting than an untested oil area either in Alaska or on the North American continent."

Asserting that the Army and Navy should cooperate, the Congressman told the House that the Navy, "which at the present time possesses the cream of American oil industry in its personnel known as the Seabees, could do a most efficient job of testing and developing this oil reserve. As a real test of cooperation, the Army should turn over immediately to the Navy any excessive wildcatting equipment which it now has available in the Canol area to be used in the testing and development of the Alaskan naval reserve."

Poulson, answering a question by Representative Compton I. White of

Can your product use the Pressurized Power in this Plane?

★ Have you ever watched a bomber fold its giant landing wheels into its wings?

The pressurized power that does this job is what we want to sell you. It is a hydraulic power system of entirely new efficiency and dependability . . . engineered for aircraft, available for all industry.

As a result of PESCO's more than ten years' specialization in making aviation pumps and related accessories, you will be able to equip your plant or product with a radically improved pumping system. For instance, you can have a compact, precision pump that delivers pressures up to 3000 pounds per square inch. This pump, weighing less than 4 pounds, forms the heart of a PESCO pressurized power system with endless uses in industry for transmitting or controlling power.

In addition to hydraulic pumps, PESCO builds pneumatic, vacuum and fuel pumps of equally high efficiencies, meeting practically all needs for pressurized power or controlled liquid flow.

The performance of PESCO equipment in your plant or product . . . its greater efficiency, dependability, and longer years of service . . . is assured by the fact that it has been engineered to operate under flying conditions which are far more extreme and demanding than any encountered down on earth. Won't you let us tell you more about PESCO Pumps and PESCO Engineering Service?

SEND FOR THIS BOOK "Pressurized Power and Controlled Flow by PESCO". This book pictorially tells the story of PESCO equipment, manufacturing facilities and engineering service. A copy will be mailed promptly upon request.

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Division Borg-Warner

In Precision Hydraulics, Fuel Pumps, Air Pumps, Related Accessories . . .
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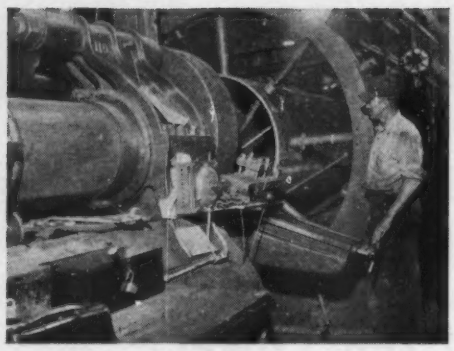
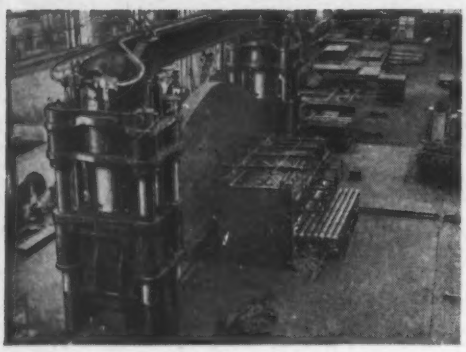
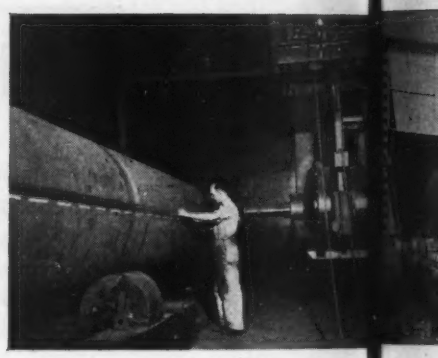






Forming

Forming facilities span the range from simple rolls (upper) to the word's largest boiler plate bending press (lower), an exceptional hydraulic machine that exerts as much as 6,000 tons pressure and can cold bend boiler plate up to 6 in. thick and 40 ft. in length.

Machining

Machine tools of great variety are the finest available and include many machines designed by C-E for special operations. The upper view shows a special lathe for machining the weld groove on the ends of drum shells. Weld grooves for longitudinal seams are machined by large planers as shown in the lower view.

Welding and X-raying

Welding facilities are of the latest types for both manual and automatic operations. In addition to the 1,000,000 volt X-ray equipment, lower view, C-E X-ray facilities include a portable 220,000 volt unit and several others of 250,000-300,000 and 400,000 volt capacity.

Combustion Engineering

200 MADISON AVENUE, NEW YORK, N. Y.

C-E PRODUCTS INCLUDE ALL TYPES OF BOILERS, FURNACES, PULVERIZED FUEL SYSTEMS AND STOKERS; ALSO SUPERHEATERS, ECONOMIZERS AND AIR HEATERS

dComplete Facilities

Annealing

For stress relieving pressure vessels C-E has several annealing furnaces of various types and sizes. One of the largest of these is shown by the lower view where a large vessel is ready to roll into the furnace.

READY FOR YOUR PRESSURE VESSEL REQUIREMENTS

Since 1930 Combustion Engineering has built thousands of welded pressure vessels of every size and variety, a large percentage for use by refineries. This work has included some of the largest and heaviest pressure vessels ever built. It has also involved fabricating and welding problems of the most exacting nature—problems that can be dealt with successfully only by an organization possessing exceptional facilities and experience. During the present war C-E facilities have been greatly expanded and are now in a position to handle a far greater volume of pressure vessel work than before, and with new benefits to the purchaser. For C-E is able to apply to this work not only the highly developed knowledge and skill acquired as pioneers in the fusion welded fabrication of carbon steels and steel alloys, but also the improved methods and techniques developed to produce a vast volume of war work.

A-747

Finished Refinery Vessels

The great variety of welded pressure vessels built by C-E for refinery use is suggested by this view of a C-E shop. Conspicuous in the foreground are (left to right) an atmospheric tower, a stripper tower, a 70,000 gallon butane storage tank, a hot oil stripper. Other partially-finished refinery pressure vessels appear in the background.

Millions of New Tires *from the Bowels of the Earth* . . . .

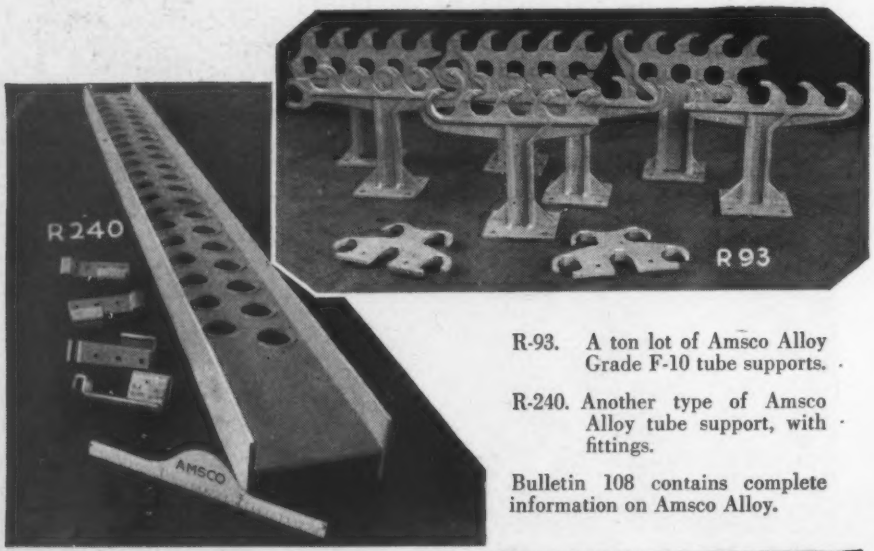
The petroleum industry has responded in a characteristically American way to the challenge raised by the rubber situation. According to the director of rubber supply, the production of synthetic rubber has reached 30,000 tons a month and is constantly increasing. Much of the material employed, of course, comes from petroleum refineries.

In this vital production, continuous operation of stills is more important than ever before. Even less welcome than in the past are those shutdowns caused by the failure of still parts under high temperatures, corrosive gases and heavy loadings.

In a number of refineries, effective insurance against production delays has been obtained by the use of Amsco Alloy still parts. This chromium-nickel alloy is made especially to maintain adequate strength at high temperatures and to resist the corrosive action of gases. It gives protection against rapid deterioration from repeated heating and cooling.

Amsco Alloy is made in a number of grades to meet various conditions of heat and corrosion. Amsco Alloy F-10, widely used in petroleum refineries, has high load-carrying strength at 2000° F., excellent resistance to corrosion, and a sufficient residual ductility when cold after a service run to avoid breakage when tubes are replaced.

Amsco Alloy castings have proved themselves in terms of longer service in such refinery applications as tube sheets, supports and hangers, brick hangers, damper doors, burner nozzles, and hot oil pump parts.



R-93. A ton lot of Amsco Alloy Grade F-10 tube supports.

R-240. Another type of Amsco Alloy tube support, with fittings.

Bulletin 108 contains complete information on Amsco Alloy.

Amsco
AMERICAN MANGANESE STEEL DIVISION
Chicago Heights, Illinois

AMERICAN Brake Shoe COMPANY

FOUNDRIES AT CHICAGO HEIGHTS, ILL.; NEW CASTLE, DEL.; DENVER, COLO.; OAKLAND, CALIF.; LOS ANGELES, CALIF.; ST. LOUIS, MO.
OFFICES IN PRINCIPAL CITIES

Idaho as to the Elk Hills reserve, criticized the abrogated contract between the Navy and Standard Oil Company (California), leading Congressman Warren G. Magnuson of Washington to explain that the Naval Affairs Committee, of which he is a member, is currently investigating that situation.

"I have no doubt that the committee and the Navy Department are going to decide all points in dispute in favor of the conservation of the Elk Hills reserve," Magnuson said.

"I may say that the Navy is in process also of attempting to find out just what we have in the so-called Point Barrow reserve, not for the purpose of developing it, because, as yet, we do not need it. The time may come when we will need it, but we are going to keep it for the Navy."

Watts Urges Cooperation In Materials Program

PAW Director of Materials Frank Watts has instructed district directors that Direction No. 1 to WPB Priorities Regulation No. 18, issued November 20, will require complete cooperation from equipment manufacturers, distributors, suppliers and operators to avoid undue interferences with production and construction programs, particularly with respect to Group B items.

Watts pointed out that the direction requires that purchase orders for Group A and B items for delivery during the first six months of 1944 be placed with manufacturers before January 1, and that purchase orders for material required for the last half of next year be placed before March 1, 1944.

The object of the direction, he explained, is to assure delivery of the listed items without delay by requiring major purchasers to place orders sufficiently far in advance to permit detailed scheduling of the manufacturing plants, in return being guaranteed scheduled delivery of their requirements.

Operators who are unable to make long-range plans are adversely affected, since the limited manufacturing capacity for many items will make it difficult to obtain delivery of materials by the time they are required for use.

Group A items covered by the direction include internal-combustion-engine accessories and components as follows: Camshafts, carburetors, crank-shafts, electric starting motors, fuel-injection equipment, generators, magnetos, mechanical governors, piston rings, pumps, radiators, automotive-type valves and heavy-duty automotive-type axles, brakes, tires, transmissions and wheels.

Group B includes: Anti-friction bearings, steel boilers (land and marine, of 100 pounds or more pressure per square inch), compressors, diesel engines, fluid power systems, heat exchangers, high-pressure blowers, industrial type wet cell batteries, electric motors and generators, electric motor controls, steam turbines, turbine generators, control valves, high-pressure plug, steel, safety and marine valves, and industrial and marine pumps.

Three specific exceptions to the general provisions of the direction are permitted, as follows:

1. The direction does not apply to either Group A or Group B items when required for maintenance or repair purposes or as operating supplies.
2. It does not apply to orders placed

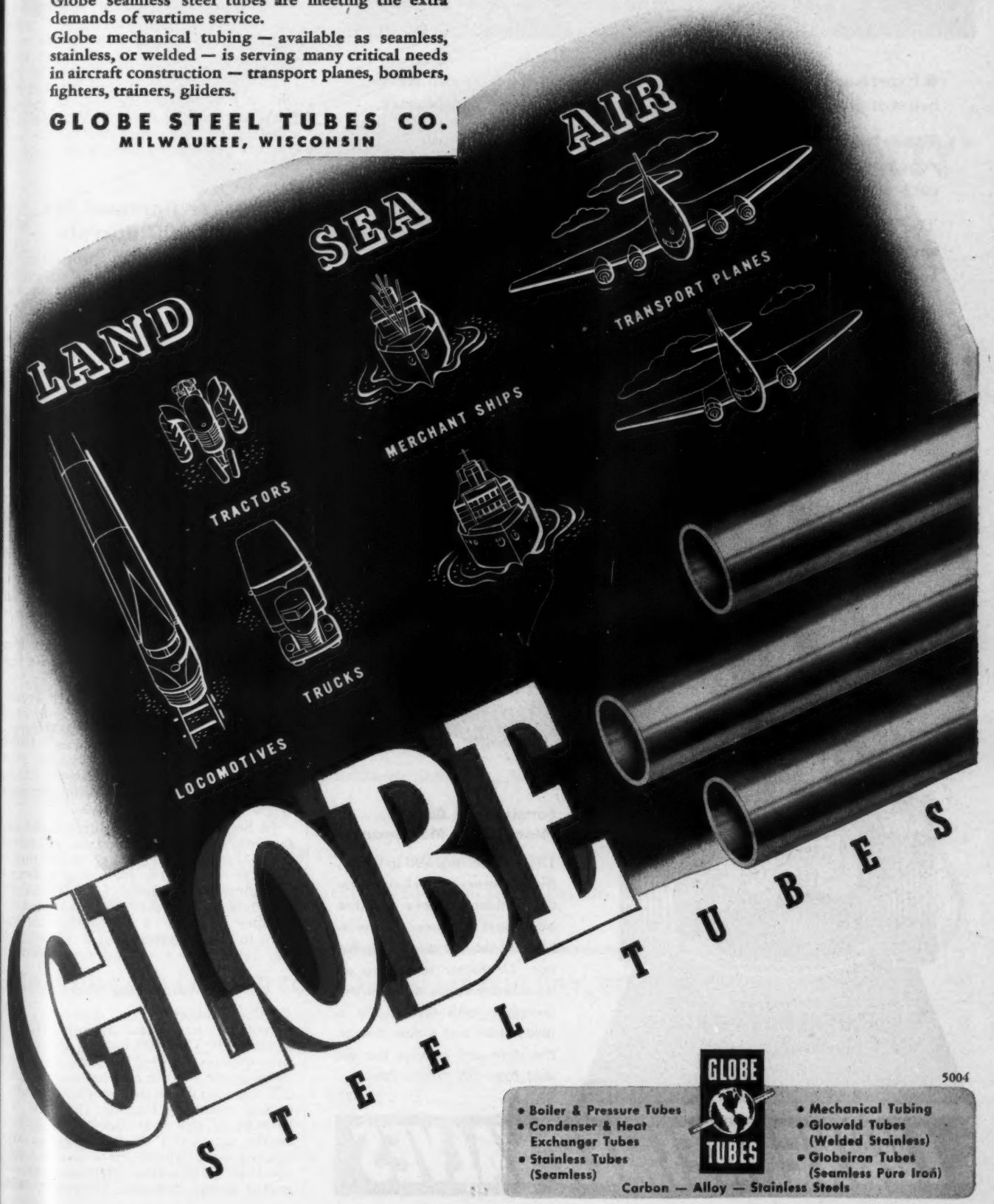
INDISPENSABLE

. . . IN THE CONSTRUCTION OF TRANSPORT EQUIPMENT

In locomotives — in the power plants of war industries — in fighting, transport and merchant ships — Globe seamless steel tubes are meeting the extra demands of wartime service.

Globe mechanical tubing — available as seamless, stainless, or welded — is serving many critical needs in aircraft construction — transport planes, bombers, fighters, trainers, gliders.

GLOBE STEEL TUBES CO.
MILWAUKEE, WISCONSIN



5004

- Boiler & Pressure Tubes
- Condenser & Heat Exchanger Tubes
- Stainless Tubes (Seamless)
- Mechanical Tubing
- Gloweld Tubes (Welded Stainless)
- Globeiron Tubes (Seamless Pure Iron)

GLOBE TUBES

Carbon — Alloy — Stainless Steels

Here's how to make your present Valves LAST LONGER..SERVE BETTER

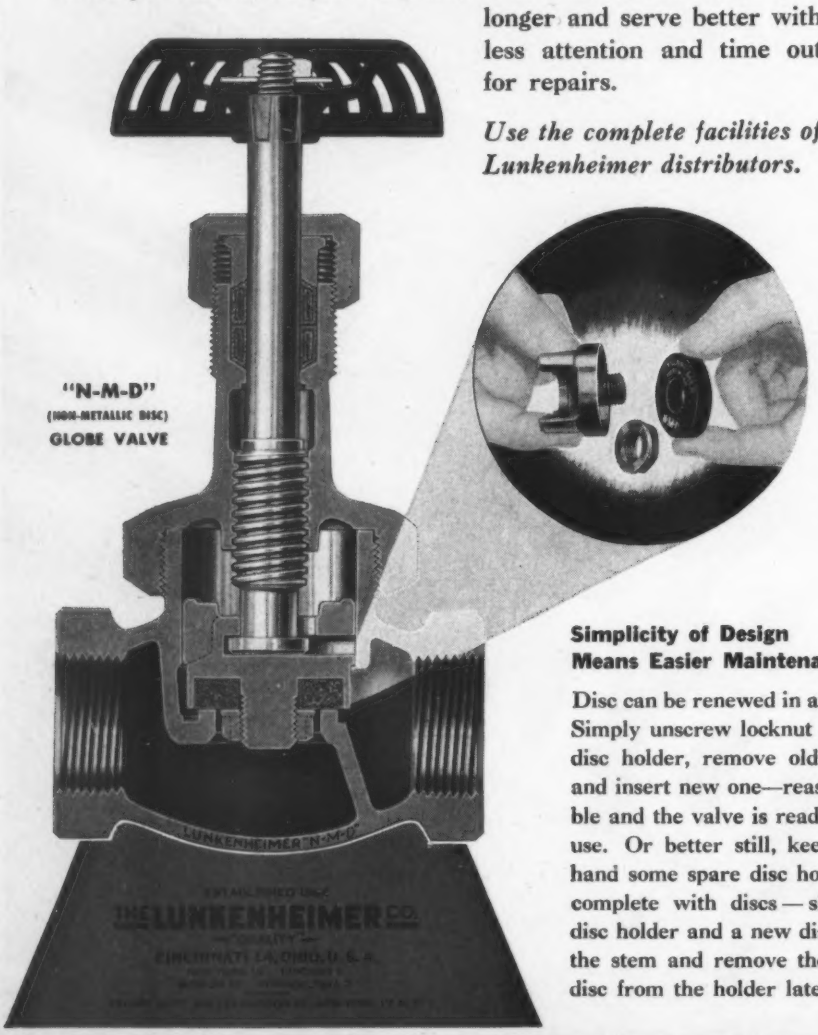
● Experience shows that even the best valves last longer and serve better if given periodic inspection . . . and repairs when necessary.

Today when new valves and even repair parts are scarce and require high priorities, it is more essential than ever to take good care of your present valves.

The Lunkenheimer "N-M-D" Valve illustrated is typical of the simple, rugged, easy-to-maintain construction that distinguishes Lunkenheimer design practice.

Thus maintenance men working with these valves find them easier to keep fit and on the job. . find that Lunkenheimer valves will last longer and serve better with less attention and time out for repairs.

Use the complete facilities of Lunkenheimer distributors.



Simplicity of Design Means Easier Maintenance

Disc can be renewed in a jiffy. Simply unscrew locknut from disc holder, remove old disc and insert new one—reassemble and the valve is ready for use. Or better still, keep on hand some spare disc holders complete with discs — slip a disc holder and a new disc on the stem and remove the old disc from the holder later.

LUNKENHEIMER VALVES

with or by distributors or suppliers who take actual delivery of the materials for resale.

3. It does not apply to orders for Group B products where all orders for any single Group B item, placed by purchaser with a single manufacturer for delivery during the same calendar quarter, have a total value of not exceeding $10,000.

It was pointed out, also that the direction does not apply to delivery orders for used or second-hand products.

Procedures have been provided by WPB for placing emergency orders after the deadlines specified in the regulations. Applications in triplicate, naming the producer with whom the purchase order is to be placed, must be filed with WPB, but may be done so through PAW, which will serve in an expediting capacity for operators and prime contractors performing petroleum construction contracts.

December Demand Set At 4,400,000 Barrels

Domestic crude oil production of 4,400,000 barrels daily will be required this month to meet anticipated demand, it was forecast December 1 by the Bureau of Mines.

That output, the bureau stated, will be 518,600 barrels, or 13 percent, higher than actual production in December, 1942, when demand was abnormally low.

With motor-fuel demand in the third quarter of this year showing a gain of about 6 percent over the corresponding period in 1942, the bureau estimated that demand for the fourth quarter will be over 11 percent above last year, reaching 168,000,000 barrels.

"Gasoline demand has been considerably greater than was anticipated because of sharp upward revisions in the estimated amount required to meet expanding military and export requirements," the bureau commented. "The supply has been augmented by a rise in crude runs to record levels and by the upward trend in gasoline yields from a low of 35.3 percent in April to a high of 38.1 percent in September."

The bureau found that daily average crude oil production for the four weeks ended October 30 was 4,399,000 barrels, while total runs to stills was 4,150,000 barrels, and stocks of domestic crude increased at a rate of 70,000 barrels, indicating a demand for domestic crude of 4,329,000 barrels daily.

In September, it was pointed out, new records were established in production at 4,347,000 barrels daily, crude runs to stills at 4,203,000 barrels and a demand for domestic crude of 4,388,000 barrels, but data available for October and November indicate a further substantial gain in crude output, but a decline from the September runs and crude demand.

Demand Rises Sharply

"The demand for domestic crude petroleum has risen rapidly from an average of 3,775,000 barrels daily in the first quarter of 1943 to 4,000,000 barrels daily in the second quarter and to 4,287,000 barrels daily in the third quarter," it was stated. "During the first nine months of the year stocks of domestic crude petroleum declined by an average of only about 1000 barrels daily, so that production virtually approximated crude demand. However, stocks

CHASE

ANTIMONIAL ADMIRALTY*

For service-proved resistance to both oil and water

Need high resistance to *both* corrosive waters and sulphur attack . . . combined in a *single* heat exchanger tube alloy?

That's the two-way service advantage you get in Chase Antimonial Admiralty . . . an alloy that combines the oil-side protection of plain Admiralty with the dezincification resistance of Red Brass. Millions of pounds of Antimonial Admiralty have been installed since 1935 — and not a single service failure has been reported from dezincification.

Like to know more about this unusual alloy? Just call the nearest Chase Sales Service Office for the complete story.

POINTS TO REMEMBER ABOUT ANTIMONIAL ADMIRALTY

1. *Extraordinarily resistant to dezincification.*
2. *Highly resistant to sulphur.*†
3. *Free from intercrystalline corrosion.*
4. *Costs no more than plain Admiralty.*

† Relatively low copper content is the reason. Antimonial Admiralty retains all the resistance to sulphur-bearing crudes that has long been a familiar feature of plain Admiralty.

*U. S. Patent No. 2,061,931

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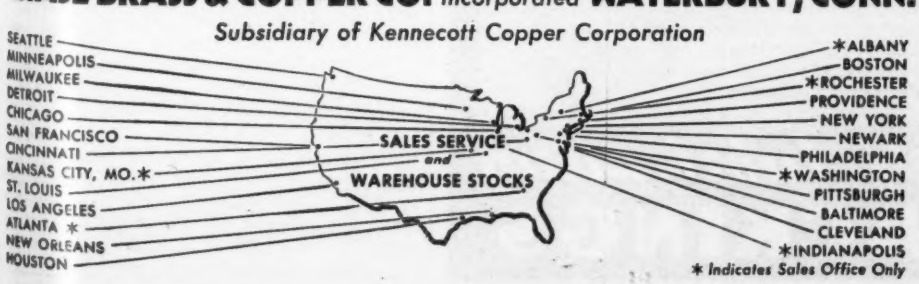
CHASE BRASS & COPPER CO. *Incorporated* **WATERBURY, CONN.**

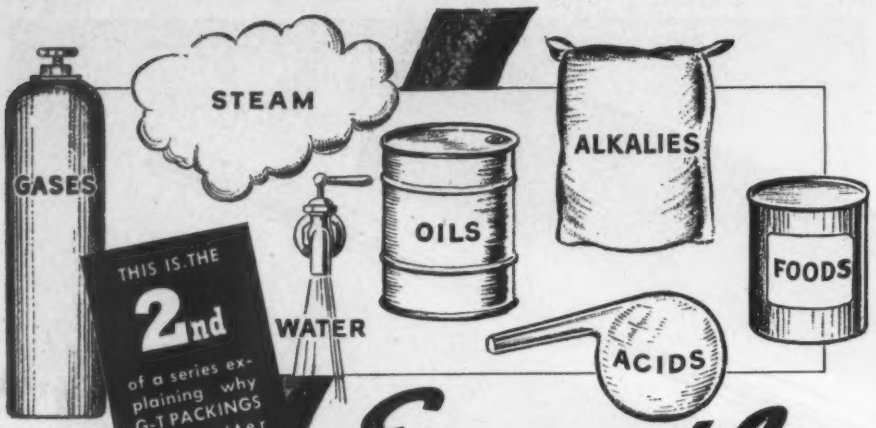
Subsidiary of Kennecott Copper Corporation



* Indicates Sales Office Only

SPECIAL STOCKS OF ANTIMONIAL ADMIRALTY *at*

Houston
Los Angeles
New Orleans
Tulsa



Exactly
the RIGHT packing for each service

8 REASONS for the Superiority of G-T Packings

1. SIMPLE LINE . . . makes correct selection easy
2. COMPLETE LINE . . . an exactly suitable type for every service
3. SELF LUBRICATING . . . each individual strand saturated with lubricant
4. SPECIAL LUBRICANTS . . . lubricant for each service specially compounded in our own plant
5. SELECTED YARNS . . . provide tensile strength and resist high temperature
6. CONSTRUCTION . . . assures maximum endurance, longest life, lowest friction
7. EXPERIENCE . . . 80 years of manufacturing experience.
8. PERFORMANCE . . . proven in thousands of plants of every type

There are no compromises in G-T packing recommendations. In yarns . . . in construction . . . in lubricants . . . each G-T packing is specially prepared and perfectly adapted to the range of service for which it is offered.

For example, SUPER CUTNO Packing is made of African blue asbestos . . . because blue asbestos best resists the action of acids. PALCO Packing is made of plaited cotton . . . because that is best suited for centrifugal water pumps. KLERO Packing is lubricated with a stainless, edible lubricant . . . to make it perfectly suitable for white paper stock, food stuffs, etc.

Therefore, when you use a G-T Packing, you can be sure of longest service . . . fullest protection to rods, shafts and stems . . . least packing maintenance expense.

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Bronx Blvd. at 238 St., New York 66, N. Y.

PALMETTO *for steam, hot water, air.* PALCO *for water.* PELRO *for oils.* CUTNO *for alkalis.* SUPERCUTNO *for acids.* KLERO *for foods, etc.* PALMETTO SUPERSHEAT **PACKINGS**

G-T *self-lubricating* **PACKINGS**

of refined oils declined by 16,000,000 barrels, or about 6,000 barrels daily during this period, and civilian consumption was restricted, so that the potential demand for crude was materially greater than the indicated demand."

The estimate for total motor-fuel demand in December is 54,500,000 barrels. Although this is 27 percent higher than the actual total demand in December, 1942, it was explained, only a portion of the increase is represented by a gain in military requirements, a considerable part of the difference being attributed to the abnormal low refinery demand a year ago that resulted from inflated sales prior to the effective date of nation-wide rationing.

Finished and unfinished gasoline inventories amounted to 69,219,000 barrels on September 30, and statistics of the American Petroleum Institute indicate a decline of approximately 900,000 barrels during October, with stocks at about 68,300,000 barrels on October 31, compared with 76,622,000 barrels on the same date in 1942. For the current month, the bureau estimates an increase of 4,700,000 barrels in finished stocks.

Direct sales of gasoline and imports are placed at 2,700,000 barrels, making an indicated refinery production of 56,500,000 barrels which is distributed among the several districts, as follows: East Coast, Inland Texas, Texas Gulf Coast, Louisiana Gulf Coast and Inland Louisiana-Arkansas, 27,480,000 barrels; Appalachian, 1,920,000 barrels; Indiana, Illinois, Kentucky, etc., 11,990,000 barrels; Oklahoma, 2,630,000 barrels; Kansas, 2,920,000 barrels; Rocky Mountain, 1,380,000 barrels; California 8,180,000 barrels.

Benzol and natural gasoline to be blended at refineries are estimated at 5,600,000 barrels. The application of an estimated 39-percent yield to the straight-run and cracked gasoline production of 50,900,000 barrels gives total crude runs of 130,500,000 barrels, or 4,210,000 barrels daily.

Chemicals Wanted

The National Registry of Rare Chemicals, Armour Research Foundation, Illinois Institute of Technology, Chicago, Illinois, has received urgent requests for the chemicals listed below. If anyone has one or more, even if only in one gram quantities, please inform the Registry.

Dichlorethylene (cis).
Dichlorethylene (trans).
Hexadiene-1,3.
Hexadiene-2,4
2-Methyl-heptene-(2)one-(6).
2-Nitro-2-methyl propane.
N-stearyl-1,2-bis (aminoethylamino) ethane.
N,N‴-stearyl-1,2-bis (aminoethylamino) ethane.
N,N′,N‴-stearyl-1,2-bis (aminoethylamino) ethane.
N,N′,N″,N‴-stearyl-1,2-bis (aminoethylamino) ethane.
N-oleyl-1,2-bis (aminoethylamino) ethane.
N,N‴-oleyl-1,2-bis (aminoethylamino) ethane.
N,N′,N‴-oleyl-1,2-bis (aminoethylamino) ethane.
N,N′,N″,N‴-oleyl-1,2-bis (aminoethylamino) ethane.

At Least Some Prices Can Go Up

A new record bonus for the privilege of drilling for oil on federal land was established November 29, when Stanolind Oil & Gas Company submitted a bid of $26,216.21 per acre for 1.11 acres of land in the Elk Basin (Montana) field, it has been announced by the Interior Department.

The offer was nearly five times the previous record of $5800 offered by the same company as a bonus bid last August on another section of the same field.

The bid was received in the offer of seven parcels of land containing approximately 72 acres, which brought a combined high bid of approximately $615,500, or an average of about $8000 per acre. Stanolind was high bidder on six of the parcels, and Ohio Oil Company topped Stanolind by $13 to make a high on the remaining parcel.

OPA has not been heard from on "holding the line," nor PAW on spacing.

Ickes Urges Manpower Be Brought Back to Industry

An urgent appeal to the industry to develop its manpower and technical equipment resources, looking toward the drilling of 5000 wildcats next year, has been issued by Ickes.

Pointing out that the industry will drill only 3400 of the 4500 wells asked for this year, Ickes admitted that it will not be possible to reach the 1944 goal of 5000 unless the current shortage is overcome, yet the only way to overcome the crude shortage which the country faces, Ickes says, is to step up the exploratory program.

Ickes pointed out that after the outbreak of the war, geophysicists and other trained workers began to leave exploratory activities for duty in the armed forces or other types of work. The loss has been minimized by the War Manpower Commission's classification of such workers as essential, he said, but it is imperative that as many as possible be brought back into the oil industry.

First Advanced Graduate At Gas Institute

Robert M. Newhall, Stoneham Massachusetts, has become the first student to complete training for an advanced degree at the Institute of Gas Technology at Illinois Institute of Technology, Chicago.

Newhall has just completed two years of graduate work in gas technology and was granted a Master of Science degree from Illinois Tech at its commencement October 17.

He is one of 24 students, all of them outstanding chemistry or chemical engineering graduates, who have been granted fellowships for study at the Gas Institute during the past two years.

Under the educational plan of the Gas Institute, about 15 students are selected each year from the nation's colleges to receive the training. All are granted fellowships, and no other students can take the work. Each of the fellows receives an annual stipend to cover expenses while studying at the institute. During the summer they are employed in the gas industry as a part of the curriculum. The fellows also assist in war research projects at the Gas Institute during their training period.

The Gas Institute was established in 1941 to perform an educational and research service for the gas industry and is supported by the industry. The educational program of the institute trains students for key positions in the industry.

Goodrich Sets Up New Chemicals Division

William S. Richardson has been named head of the newly-created chemicals division of B. F. Goodrich Company. Richardson entered the rubber industry in 1914 and joined the company in 1926 on the staff of the assistant works manager. He was shortly after assigned to the industrial products division, later becoming divisional staff superintendent. In 1931 he was appointed merchandising manager of the division's sales organization, and in 1942 became general manager of industrial products and sundries sales.

Distribution of Wax Transferred to PAW

Control over the distribution of microcrystalline wax, formerly exercised by the War Production Board through M-195, has been transferred to PAW, where the WPB order has been reissued as PDO-19.

The PAW control order differs from M-195 only in minor respects, the most important of which is that whereas hertofore deliveries of the wax was limited to 12,000 pounds a month it is now provided that no supplier shall deliver in any calendar quarter more than 2½ percent of his production during that period without special direction of the director of marketing.

Gulf Completes Thermofor Unit at Port Arthur

Gulf Refining Company has recently put into operation a Thermofor catalytic cracking plant at its Port Arthur, Texas, refinery. The new units produce butylenes, the basic ingredient of butadiene.

Industrial Plastics

The revised second edition of Industrial Plastics, a comprehensive, compact simply written book which provides information on the sources, chemistry, manufacture, fabrication, utilization of this vital modern material, is available from the Pitman Publishing Corporation, 2 West 45th Street, New York. The author is the consulting engineer and specialist in plastics, Herbert R. Simonds, who came to the plastics industry by way of steels and their alloys and processes.

New material on the wartime use of plastics is especially timely, and so is the material on recently developed types, including fibers and bristles. The author has, in the light of late research, completely rewritten the chapter on chemistry and has brought up to date all charts, tables, formulae, and statistics. New markets are suggested through hundreds of applications in scores of industries. Time and money-saving ideas occur in "Improved Production Methods." Products, equipment and processes of the entire plastics industry are described.

Purposely non-technical, this book is valuable to technical men and research workers because of the industrial emphasis. Price of the book is $4.50.

Tanker Withstands Torpedoes

The over-age tanker "Gulfprince", operated for the War Shipping Administration by the Gulf Oil Corporation, successfully dodged four torpedoes in in the Gulf of Mexico last May and was slightly damaged by a fifth, but had worse luck more recently in the Mediterranean, when one torpedo, smashing a main tank, disabled the vessel, it was disclosed by WSA December 2.

The report was one of a series of stories which are being released by the WSA on the war exploits of our merchant shipping.

After the Mediterranean attack, the 22-year-old tanker caught fire and the crew took to the lifeboats, making the shore ten miles away with no losses, although a gunner suffered severe burns. When the fire subsided, a Navy tug towed the vessel to the nearest port, where temporary repairs were made, and then to another port for complete overhaul.

In both attacks, the ship was commanded by Captain Peter J. Sigona of Port Arthur, Texas, who was awarded the Merchant Marine Distinguished Service Medal for saving his vessel in the first submarine attack.

Shell Magazine Awarded Outstanding Trophy

Shell Oil Company announces that Shell Progress, its widely read, bimonthly magazine, has received the certificate of award as one of the direct mail leaders of 1943. The award is made annually to some publication at the close of a campaign conducted by the Direct Mail Advertising Association.

Selection as one of the 50 direct mail leaders among corporation publications distributed throughout the United States and Canada is made yearly by the association on the basis of outstanding effort to promote greater understanding and appreciation of mail advertising.

This certificate, now received by the magazine for the third time within three years, is the latest of a number of awards and trophies won by Shell Progress since 1940 for the high quality and character of its contents and appearance.

Federal Collections Show Effects of Rationing

Federal gasoline tax collections in October touched the lowest level reached in any month since last June, amounting to $22,863,919 compared with $25,146,358 in September and $31,622,272 in October, 1942, it is shown by the monthly report of the Internal Revenue Bureau.

Lubricating oil taxes, however, were at a high level, $5,645,908 compared with $3,837,508 in the preceding month and $3,266,338 in the corresponding month last year, and pipe-line taxes of $1,342,187 also were above the September figure of $1,132,911 and the October, 1942, receipts of $1,113,175, it was stated.

For the 10 months ended with October, gasoline tax collections aggregated $217,152,685, a loss of more than $70,000,000 from the $287,512,520 recorded in 1942 but lubricating tax revenues were up more than $7,000,000, $42,221,044 against $34,810,314, and pipe-line tax collections also showed an increase, $11,725,810 against $11,363,948, it was shown.

SCIENCE AND TECHNOLOGY

Abstracts prepared in co-operation with the

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by

THE LESLIE LABORATORIES

Traver Road, Ann Arbor, Mich.

under the supervision of

DR. E. H. LESLIE and DR. H. B. COATS

The abstracts here presented are selected from the current literature of science and technology to afford reference to fundamental information not easily available to all readers. Abstracts of articles appearing in readily obtainable trade journals are not included.

Photostat copies of original articles will be supplied at cost by the Leslie Laboratories. Complete or limited bibliographies covering special topics by title, by abstracts, or in complete manuscript, will also be prepared and furnished at reasonable cost by the Laboratories.

Fundamental Physical And Chemical Data

Vapor Pressure Slide Rule, F. T. MILES, *Ind. & Eng. Chem.* **35** (1943) pp. 1052-61.

The variation of vapor pressure with temperature is important in many fields. The laws and equations generally used to calculate the variations are awkward to apply and subject to inaccuracies. A slide rule has been developed that rapidly performs such calculations for all pure liquids with normal boiling points in the range —38° to 400° C. The rule has two independently adjustable slides corresponding to the two variables—boiling point and entropy of vaporization (Trouton's constant). Any liquid is represented by a particular setting of the two slides; when this setting has been made, the entire vapor pressure curve can be read from adjacent pressure and temperature scales; the critical point and molal heat of vaporization at the boiling point are shown. Index points mark the settings for 87 known liquids. Settings for seven classes of liquids are shown by lines. Additional scales perform gas law calculations and conversions of temperature, pressure, and heat values to different units.

Viscosity of n-Paraffin Solutions, A. R. KEMP AND H. PETERS, *Ind. & Eng. Chem.* **35** (1943) pp. 1108-12.

Viscosity measurements of equal base molar solutions of the n-paraffins in n-hexane have shown good agreement with the Staudinger relation that requires the specific viscosity to be proportional to the number of atoms in the chain. A comprehensive analysis of viscosity molecular weight data on various linear polymers has led to the development of a new viscosity constant, K_{ca}, based on the contribution to viscosity of a chain atom. It is shown that $K_{ca} = \log n_r W/\phi N$. The range for K_{ca} is 0.030 to 0.038, with an average of 0.043. By the use of this average K_{ca} value in the equation, the polymer length can be calculated even in the case of a non-linear type since the side chains of a branched-chain polymer have little influence on viscosity. The paper gives new emphasis to the correctness of the underlying basis for the measurement of molecular weights of linear polymers by the viscosity method. The data secured in the work are presented in considerable detail in both tabular and graphical form.

The Pressure - Volume - Temperature Relations of 2,2-Dimethylbutane, W. A. FELSING AND G. M. WATSON, *Jour. Amer. Chem. Soc.* **65** (1943) pp. 1889-91.

The pressure-volume-temperature relations of 2,2-dimethylbutane were determined at 25° C. intervals from 100° C. to and including 275° C. at pressures ranging from one or two atmospheres above the vapor pressures to approximately 300 atmospheres. Data are presented in tabular and graphical form, the specific volumes in cc./g. being related to the pressures at different temperatures. No data within the range of the experimental work have been found in the literature for this hydrocarbon. Density and refractive index, normal boiling point, and critical temperature and pressure for the hexanes are given, as well as values determined by others for comparison.

Surface Tension of n-Heptane and n-Butane Containing Dissolved Nitrogen, G. J. RENO AND D. L. KATZ, *Ind. & Eng. Chem.* **35** (1943) pp. 1091-3.

Surface tensions of n-heptane containing dissolved nitrogen were measured at 200, 500, and 1000 pounds per square inch at 77°, 131°, and 185° F., and of n-butane containing nitrogen at the same pressures and at 77° F. The data were used to compute a parachor for nitrogen dissolved in n-heptane of 41. When dissolved in n-butane, the parachor for nitrogen is 60, which is in agreement with the value obtained for pure nitrogen. Knowing a parachor it is possible to calculate the effect of nitrogen on the surface tension of hydrocarbon mixtures. Data are presented in detail in tabular and graphical form.

The Ultraviolet Absorption Spectra of Arylethylenes, R. N. JONES, *Jour. Amer. Chem. Soc.* **65** (1943) pp. 1818-24.

The ultraviolet absorption spectrum of tetra-(9-phenanthryl)-ethylene are given and compared with that of a four molar solution of phenanthrene. The observations draw attention to the factors influencing the absorption spectra of the arylethylenes, and it is shown that substances of the general formula $R_1R_2C = CR_3R$. C_6H_5 where R_1, R_2, and R_3 may be H or C_6H_{5-}, can be divided into two groups depending on whether their spectra resemble that of styrene or of trans-stilbene. cis-Stilbene, which has a spectrum intermediate in character between the two types, is the only exception to this generalization. An explanation of this optical behavior is offered, based on a consideration of the steric factors which interfere with the attainment of the most stable resonance structures.

Hyperconjugation in Methyl Butadienes as Shown by Dipole Moments, N. BRUCE HANNAY AND C. P. SMYTH, *Jour. Amer. Chem. Soc.* **65** (1943) pp. 1931-34.

Dipole moment measurements have given significant evidence as to hyperconjugation in the molecules of aldehydes, nitriles and chlorides. The dipole moments found for a number of unsaturated hydrocarbons gave sufficient evidence of hpyerconjugation in their molecules to warrant the use of moment measurements in the investigation of the simple substituted butadienes. The dielectric constants of the vapors of butadiene, 1-methyl-, 2-methyl- and 2,3-dimethylbutadiene were measured and used to calculate the dipole moments of the molecules. The moment of 2,3-dimethylbutadiene shows that the molecules are largely, if not entirely, in a cis form with respect to the central C-C bond. The moment values give quantitative evidence in support of the theory of hyperconjugation, which requires positive charges on the methyl hydrogens and a negative charge on a terminal carbon.

Chemical Compositions And Reactions

Hydrogenation of the Triple Bond, A. L. HENNE AND K. W. GREENLEE, *Jour. Amer. Chem. Soc.* **65** (1943) pp. 2020-3.

Monoalkylacetylenes, treated with sodium in liquid ammonia, are one third hydrogenated to the corresponding olefins, and two thirds metalated. Dialkylacetylenes are reduced to the trans olefins, the physical properties of which are markedly different from those of the olefin obtained by catalytic hydrogena-

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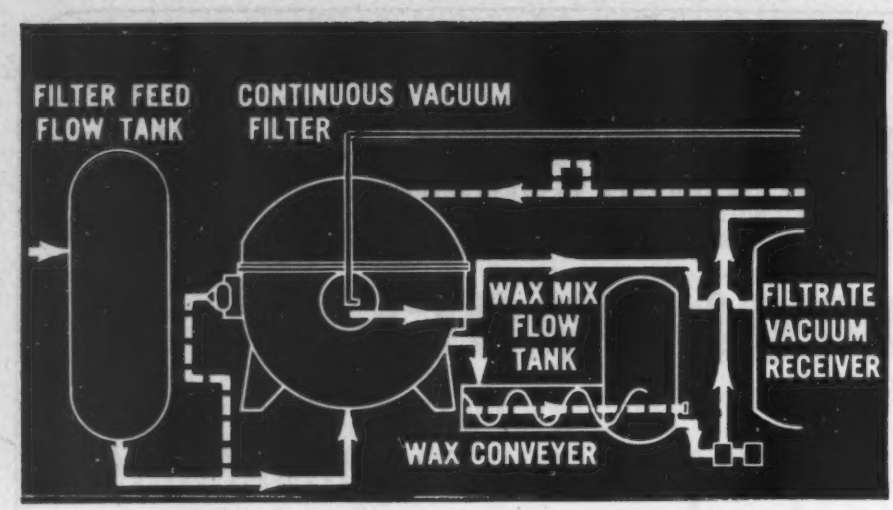

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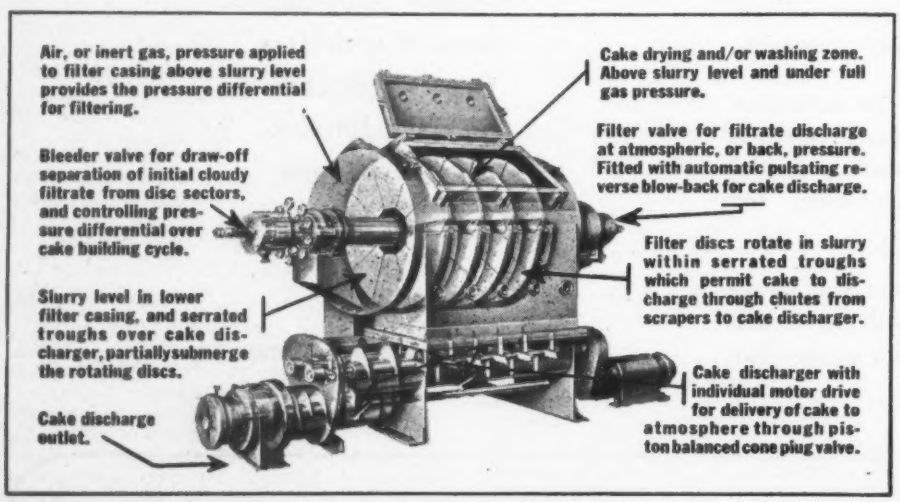
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tion. Monoalkylacetylenes can be reduced quantitatively by the theoretical amount of sodium in liquid ammonia containing an ammonium salt and no hydrogen escapes. Under the same circumstances dialkylacetylenes are inefficiently reduced, hydrogen is found, and more than the theoretical amount of sodium is consumed. Ammonium chloride, which is appreciably soluble in liquid ammonia, gives off some hydrogen and causes an inefficient reduction in every case, while ammonium sulfate, which is nearly insoluble, proved almost 100% efficient in the reduction of monoalkylacetylenes. From these results it is deduced that the hydrogen released from the acetylene molecule is more effective for reduction than the hydrogen from the ammonium ion, and that the function of the ammonium salt is to regenerate the acetylene from its sodium derivative.

Catalytic Dehydrogenation. I. Catalytic Conversion of Alcohols into Aldehydes, Paraffins and Olefins, E. J. Badin, *Jour. Amer. Chem. Soc.* **65** (1943) pp. 1809-13.

The liquid-phase nickel-catalyzed conversion of representative members of the homologous series of primary aliphatic alcohols into the corresponding aldedye, an unsaturated hydrocarbon of one less carbon atom and the saturated hydrocarbon of one less carbon atom was studied. In view of the fact that hydrocarbons with an odd number of carbon atoms and higher paraffins containing more than eight carbon atoms are difficult to obtain or prepare by the usual chemical methods, catalytic dehydrogenation followed by deformylation and hydrogenation, occurring in one step without the use of pressure or an external source of hydrogen, affords an easy method of preparing these hydrocarbons. The reaction can be regarded as a preparative one for aldehydes and hydrocarbons. Temperatures in the range 140° to 275° C. were studied and the amount of catalyst used was generally 5%. Higher temperatures caused an increase in the rate of reaction but a more rapid decrease in the activity of the catalyst. Although the exact mechanism of the reaction was not determined, evaluation of the data shows that the reaction probably proceeds consecutively by dehydrogenation, deformylation, and hydrogenation, the extent to which each reaction occurs being influenced by temperature and time. Among the primary alcohols studied were pentanol, octanol, nonanol, decanol, dodecanol, and hexadecanol. The results are presented in tabular and graphical form.

The Nitroparaffins, H. B. Hass and E. F. Riley, *Chem. Reviews* **32** (1943) pp. 373-430.

Nitroparaffins were first produced commercially in May, 1940, at Peoria, Illinois, by the Commercial Solvents Corporation, using a vapor phase nitration. The work that has been done to date leads to certain generalizations: tertiary hydrogen atoms are most readily attached, secondary hydrogen atoms more slowly, and primary hydrogen atoms least readily. Yields and conversions are higher at higher temperatures. Fairly extensive oxidation accompanies nitration. Some polynitroparaffins are formed. Isobutane was the first hydrocarbon nitrated in the vapor-phase. It has one tertiary hydrogen atom. Sealed in a tube and heated at 150° C. it yields tertiary nitrobutane in 15 minutes. Nor-

3 of the 7

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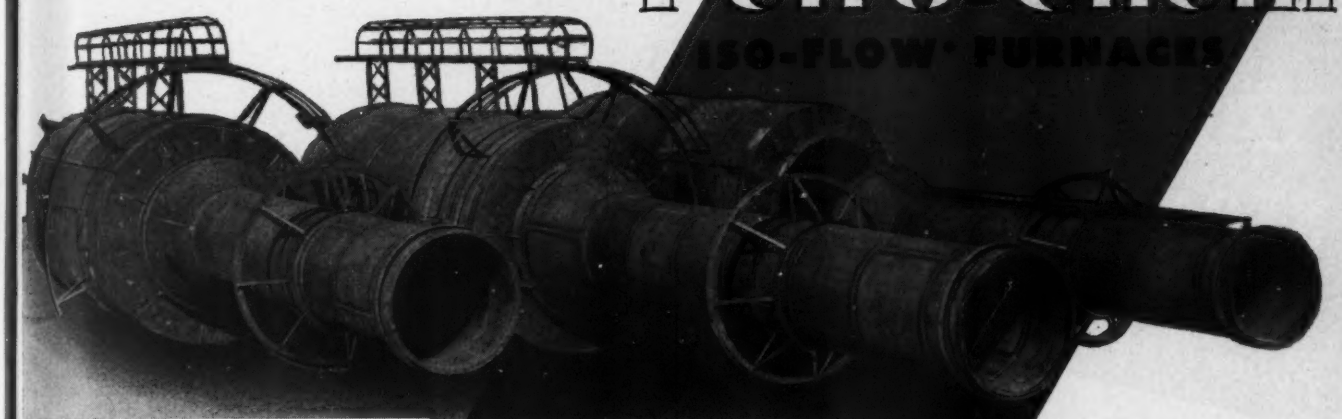

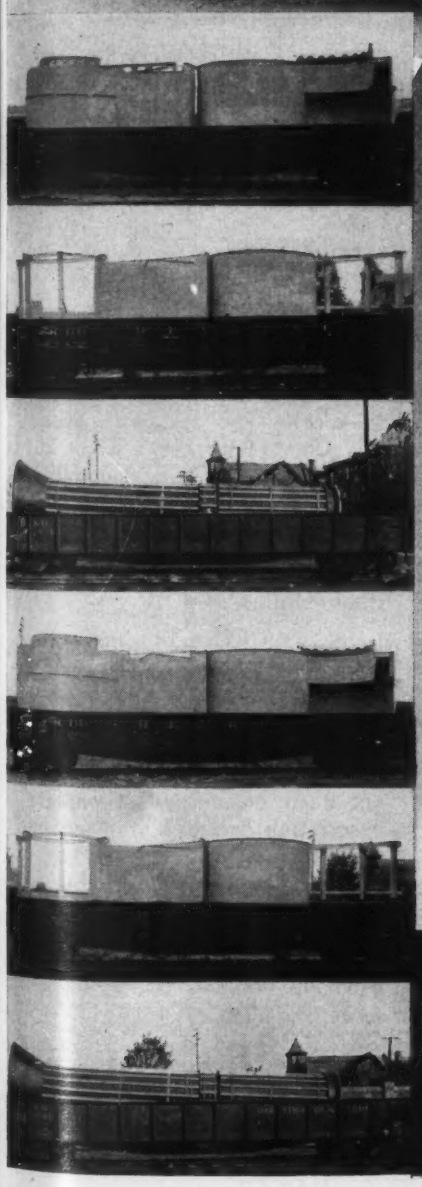

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mal butane was measured in the same manner. When a vapor-phase nitrator was used the reaction was slower and the temperature required higher. The range from 400 to 450° C. is best. The liquid formed was a mixture of 1-nitro-2-, ethylpropane with 2-nitropropane and nitromethane. The increase of pressure increases the rate of reaction. All the catalysts studied so far have accelerated oxidation at the expense of nitration. Approximately 40% of the nitric acid passing through the reactor appears in the form of nitroparaffins. The rest acts as an oxidizing agent forming alcohols, aldehydes, acids and ketones, oxides of carbon, and water. In vapor phase nitration the structure of the hydrocarbon is less important than in liquid-phase nitration. The physical properties of the nitro- and dinitroparaffins are summarized in a table. All of the mononitroparaffins are colorless when pure, have dipole moments of about 3.2 and boil at temperatures from 101.7° C. up. Most organic solvents are miscible with nitroparaffins. The dinitroparaffins are colorless and usually are crystalline solids insoluble in water and soluble only to a limited extent in the paraffins. The nitroparaffins in general are not extremely toxic. At present they are used in the making of chemical intermediates. Nitroparaffins are reduced to amines, alkylhydroxylamines and oximes.

The Influence of the Amount of Air Upon the Oxidation of Paraffin Hydrocarbons, H. PARDUN AND R. KUCHINKA, *Fette u. Seifen* **49** (1942) pp. 441-6.

The optimum amount of air for the oxidation of aliphatic hydrocarbons to acids in liquid phase was determined by oxidizing a "Fischer-Tropsch-Gatsch" substrate at temperatures from 100° to 160° C. with 0.05 to 1.0 liters of air per gram per hour until an acid number of 50 resulted. The rate of oxidation increased with temperature until a limiting value was reached and then remained constant. The temperature coefficient in the range from 110° to 140° C. remained practically constant at 2.52. Above 140° it fell to the range 0.80-1.70.

Some Formaldehyde Derivatives of Acetylenic Hydrocarbons, G. F. HENNION AND E. P. BELL, *Jour. Amer. Chem. Soc.* **65** (1943) pp. 1847-8.

With the exception of formaldehyde, most aldehydes and ketones react readily with sodium acetylides in liquid ammonia to yield the various alkynyl carbinols. As typical examples of potentially suitable A-Ch_2-B reagents the authors investigated the reactions of several chloromethyl esters, chloromethly ethers, methylene bromide and methylene sulfate with sodium acetylide and acetylenic Grignard reagents under a variety of conditions. Nine products were made. The physical constants, yields and analytical data for these products are set forth in detail in tabular form.

Effect of Paraffins on Nitration of Toluene, W. D. GLOWACKI, *Blast Furnace Steel Plant* **31** (1943) pp. 659-64, 771-5.

Paraffin hydrocarbons were oxidized by nitrating agent used for the nitration of TNT. This leads to waste of acids and the products of oxidation remain in the finished TNT and lower its freezing point. It was found that the number of off-specification products increases when

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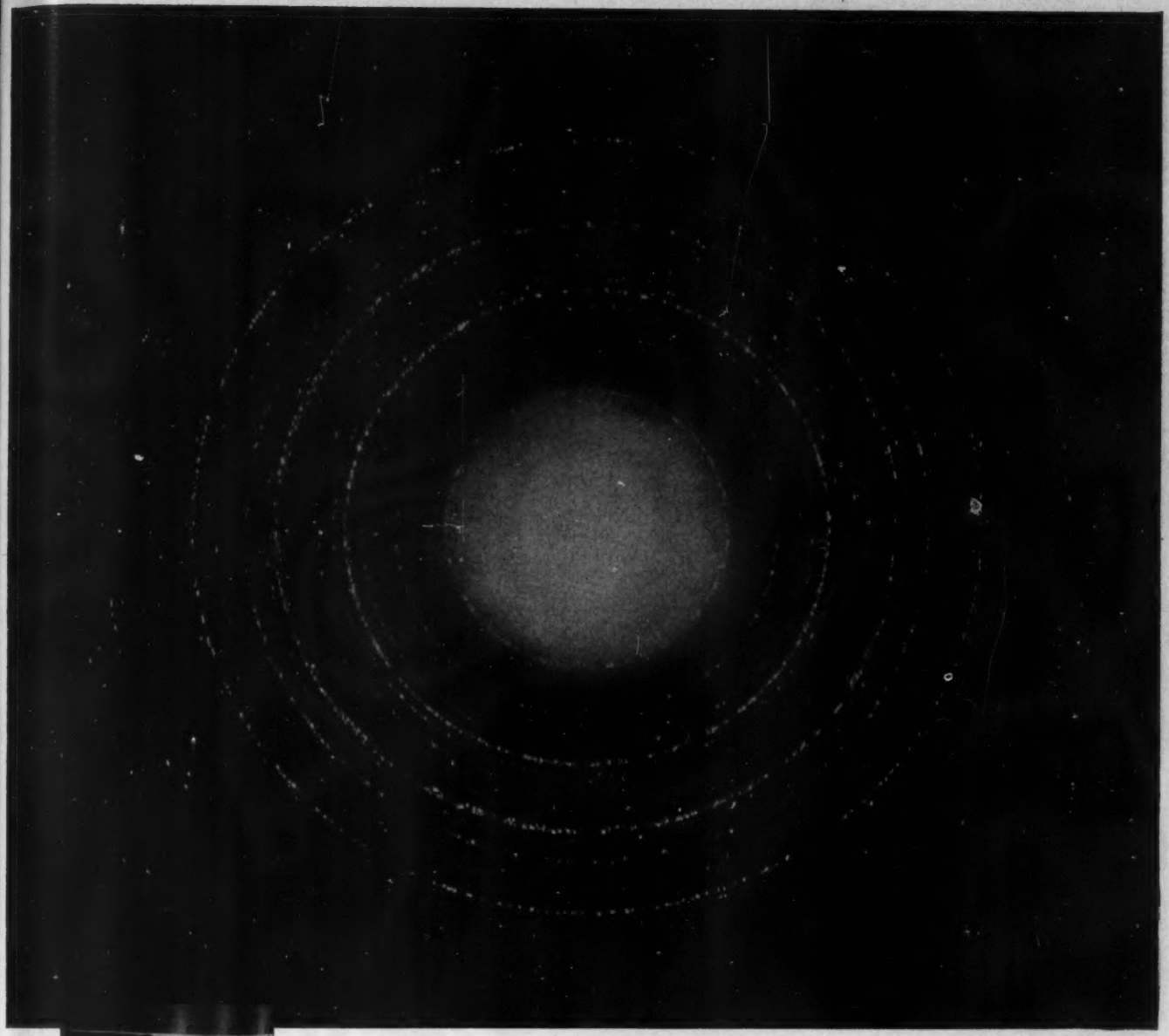

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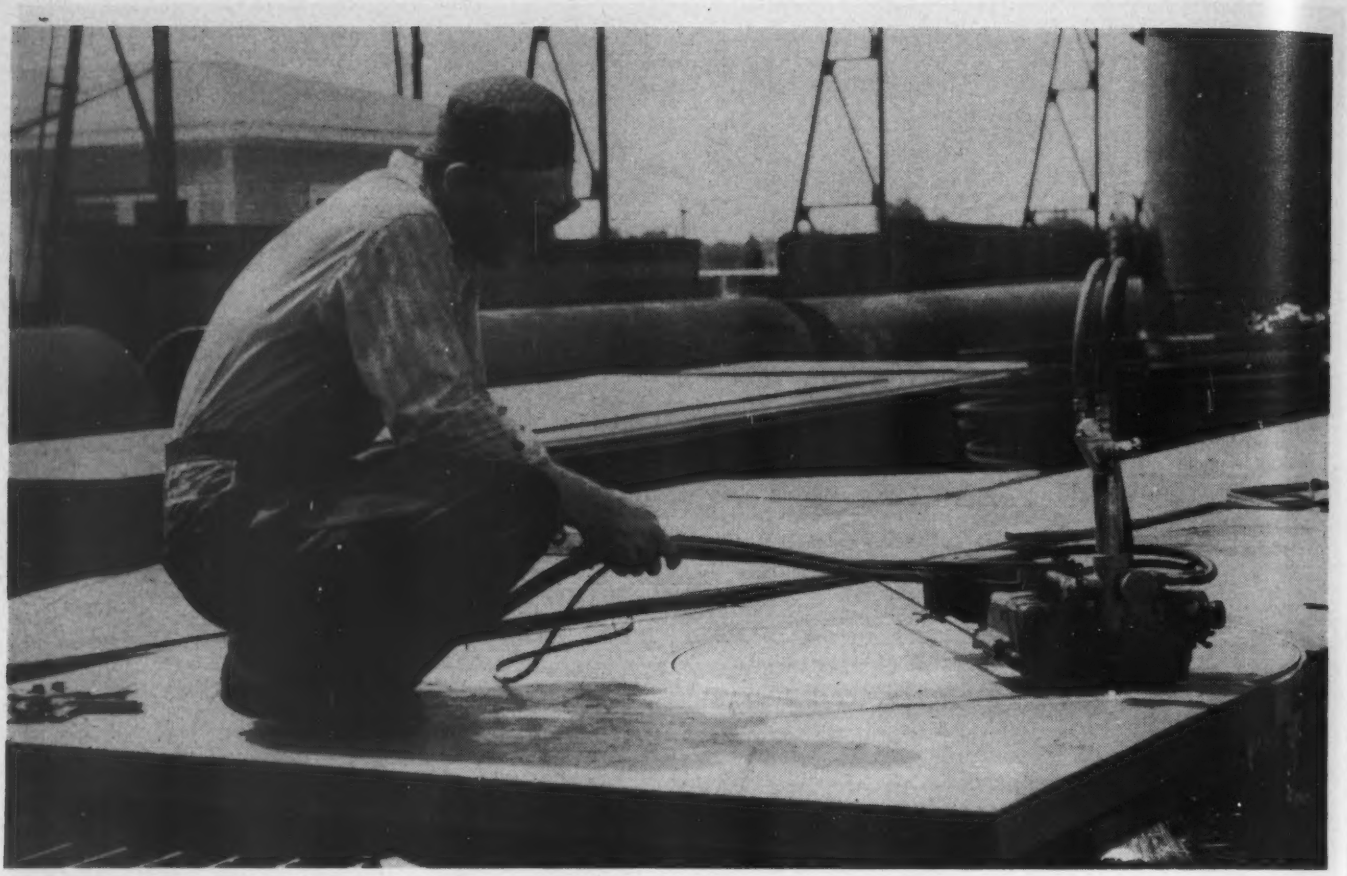

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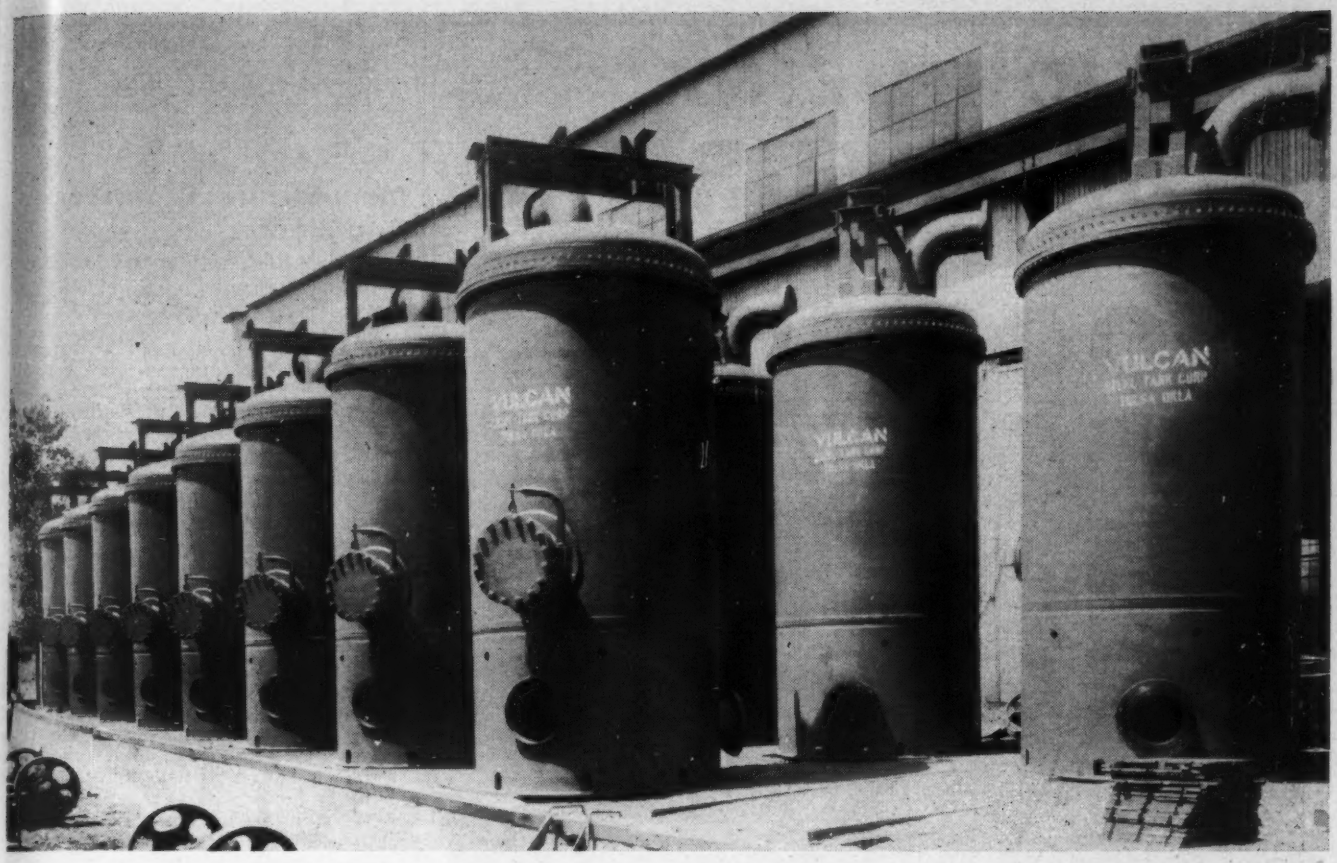

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REFINERY COMPOSITE CATALOG

Pages 652-653

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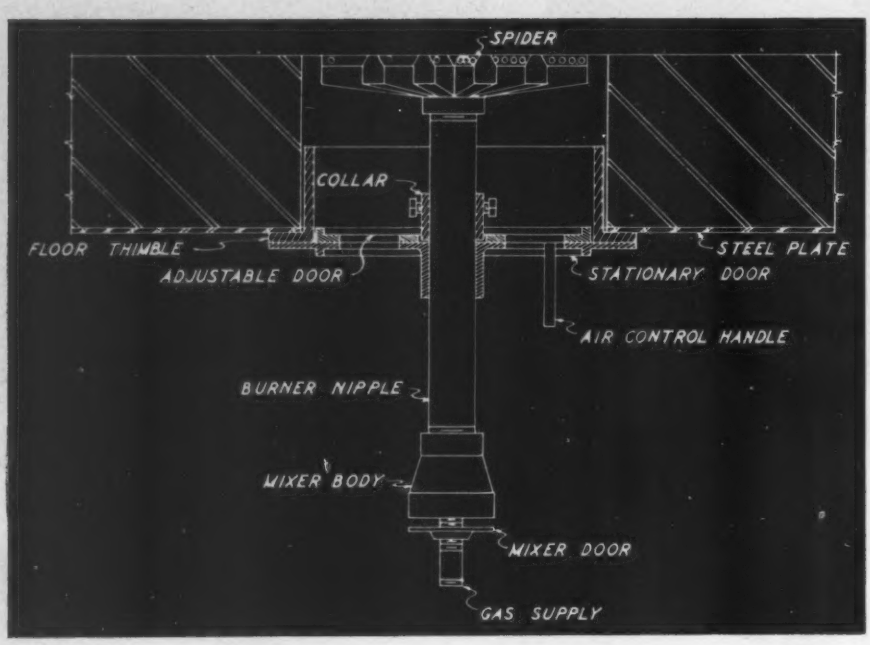

John Zink-VBM-Gas Type Burner

The John Zink-VBM-Gas Type Burner fires a furnace to a higher rating—more evenly—than any other way possible.

It burns with an extremely short flame.

Performs well with extremely low draft.

Its special construction makes for better distribution of air for combustion.

In large sizes the VBM can be used for access door—for inspection of furnace.

Sizes: 14", 16", 18", and 20" diameters. The John Zink Oil Burners MTH or MTB are inserted through center of the spider, to make the John Zink VBM-Combination Type Burner.

The John Zink FOUNDRY has the experienced supervision and facilities to make light castings involving numerous small cores.

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high-paraffin toluenes are used. TNT plants have been designed to use toluene containing not over 1% of paraffin, but some high-paraffin toluene can be used by blending. Only a few coke-oven plant operators are unable to make toluene containing less than 1% of paraffin.

Manufacture: Processes And Plant

Condensation of Vapors, D. F. Othmer and S. Berman, *Ind. & Eng. Chem.* **35** (1943) pp. 1068-77.

The film coefficients of heat transfer for the condensation of eighteen alcohols, esters, and ketones were determined at their normal boiling points over a wide range of temperature differences, by the method previously described by the authors. Vapor velocity and temperature difference along the tube were both held constant, which reduces the variables to: (a) the material itself—i.e., the chemical configuration of the vapor molecules; (b) the temperature difference from vapor to tube surface. The method was modified to allow for possible decomposition of alcohols, which gives amounts of noncondensable gases large enough to reduce the coefficients seriously. The data agree among themselves within the relatively low experimental error; they were correlated with the physical properties controlling condensation and were well within the accuracy of the physical data available. The data are presented in considerable detail in tabular and graphical form.

Nonchlorinated Compound Derived from Monochloropentanes, C. K. Hunt, *Ind. & Eng. Chem.* **35** (1943) pp. 1048-52.

Chloropentanes are produced by the high-temperature vapor-phase chlorination of a mixture of pentane and isopentane. Nonchlorinated compounds derived from monochloropentanes are described and some of their uses indicated. Flow sheets and operating procedures for producing amylphenols, amylnaphthalenes, amylamines, and amylmercaptan are given. p-tert-Amylphenol, or Pentaphen, is about 50 times as powerful as phenol for killing certain types of bacteria. An outstanding property is the oil solubility of products made from it. Thus, Pentaphen condenses with formaldehyde to form resins that are soluble in drying oils. Such resins produce varnishes with a high resistance to weathering. o-Amylphenol is used as an antiskinning agent for paints, varnishes, and enamels. Diamylphenol is used as a repellant in soil fumigants. The amylnaphthalenes are oily, high-boiling stable liquids of interest as heat transfer media and coupling agents. It can be used as a vehicle in ink, and to make wetting agents for the textile industry. The sulfonates are emulsifiers. Di- and polyamylnaphthalenes are plasticizers. The amylamines are emulsifying agents. Amyl mercaptan has a typical mercaptan odor and is sold as a warning agent for natural gas and other gases.

The Solvent Extraction of Lubricating Oils, H. ter Meulen, *Jour. Inst. Petr.* **29** (1943) pp. 237-52.

The first solvent-extraction plant in the oil industry operated according to the Edeleanu process, and treated kerosine with liquid sulphur dioxide. Later

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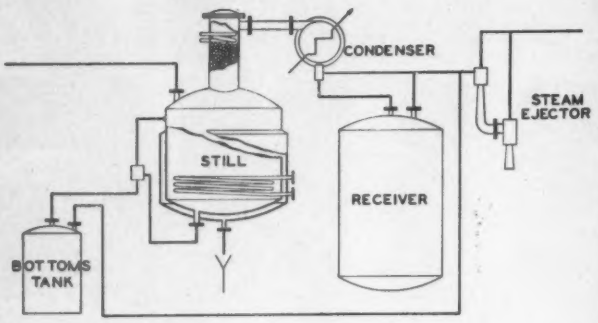

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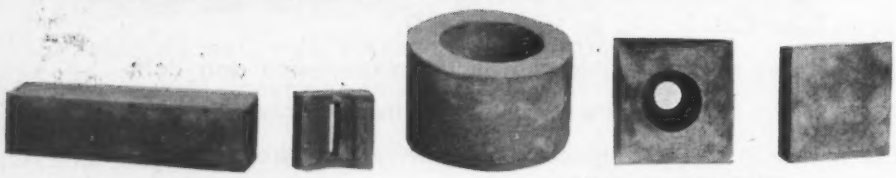

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DOMESTIC for patching and repairing where good plasticity and workability are important.

RECOMMENDED FOR monolithic furnace hearths, door linings, baffles, burner blocks and special refractory shapes.

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Literature more fully describing Kastic and Kel-Crete is available and will be forwarded upon request.

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processes were used for the improvement of lubricating oils. The main difference between kerosine and lubricating-oil extraction lies in the fact that kerosine is composed of two or three groups of components, which in each group can be considered to react as a single compound, whereas lubricating oils, although composed of the same three group components, differ widely in the composition of any one component. Chemical composition can be used in the control of paraffin fractions. Viscosity index has been used as a means of control in lubricating oil extraction. However, the lubricating oil with the highest viscosity index is not always better than other oils of lower viscosity index. A chart is included showing the typical composition of various types of residual lubricating oil stock. Material of a given viscosity index from one crude may be quite different, chemically speaking, from that of the same viscosity index from another crude. The two main properties of solvents, namely solvent power and selectivity, are discussed in some detail. The principles involved are illustrated by a comparative discussion of aniline and nitrobenzene as solvents. Of the solvents that are presently used in practice, i.e., sulphur dioxide, phenol, furfural, chlorex, nitrobenzene and sulphur dioxide-benzene, it can be said that sulphur dioxide has the highest selectivity but a very low solvent power, whereas phenol and furfural have the lowest selectivity but a high solvent power. From this it can be seen that for the extraction of Pennsylvanian or Mid-Continent lubricating-oil, sulphur dioxide is in an unfavorable position, as the solvent power for intermediate viscosity index fractions is low. However, for the production of intermediate viscosity index oils from naphthenic base stocks sulphur dioxide is the most suitable solvent. The effect of reflux in extraction is discussed. Selectivity by molecular weight is considered. Lower molecular weight fractions tend to over extract, while heavy fractions are not sufficiently extracted. The remedy is obvious—the cuts should have been made before extraction and then extracted separately. The characteristic of all solvents in selecting by molecular weight is the reason for the impossibility of extracting steam refined residues with a single solvent to a suitable raffinate. Steam refined residues represent the ultimate case of a very wide cut. No single solvent has such a low light/heavy selectivity that all asphalt is removed from the raffinate into the extract layer. Therefore single-solvent extraction processes are properly applicable only to distillate fractions. The use of two solvents such as a mixture of phenol and cresols along with propane is considered. The solubility of asphaltenes in propane is negligible, and therefore they are precipitated from the raffinate layer into the extract.

Products: Properties And Utilization

Valves and the Bromide Blight, *The Commercial Motor* **78** (1943) p. 74.

The damage to the exhaust valves from the combustion gases in explosion motors is probably caused by bromine or lead bromide from the ethylene dibromide. The volatilized lead bromide condenses on the valves and valve seats when they are cold. As the motor is warmed, the bromide fuses and attacks it. The bromides are revolatized at about

50

PHANTOM BLOOD DONORS

There's thunder up ahead and the ground is quaking. The guns are at it again. ★ ★ But you're out of it now. You've gotten yours so badly that they had to carry you back to an emergency station. They brought you back quickly, so maybe you've still a chance. You lie still, feeling your strength going fast. ★ ★ Dimly, you notice a rifle standing upright beside you, its bayonet jabbed deep into the earth. From its butt is suspended a bottle, and from that a rubber tube dips toward you. ★ ★ So they're going to give you a blood transfusion. ★ ★ You feel a pricking sensation in your arm, and you realize that life-giving fluid is flowing from that bottle into your veins. ★ ★ You're going to be saved! In your heart you give thanks to the folks back home who gave their blood that you might live. But what you don't know is that among these donors there can be 50 phantoms for every 1000 real donors. ★ ★ The 50 Phantom Blood Donors are created by a centrifugal machine which separates the blood into corpuscles and plasma. At least five per cent of the plasma separated in the conventional way was lost until The Sharples Corporation perfected and made available a Sharples Super-Centrifuge which, by recovering more plasma to be processed into albumin, creates, in effect, 1050 blood donors where there were only 1000 before. ★ ★ Now, gallant men are kept alive by precious plasma that used to be lost.

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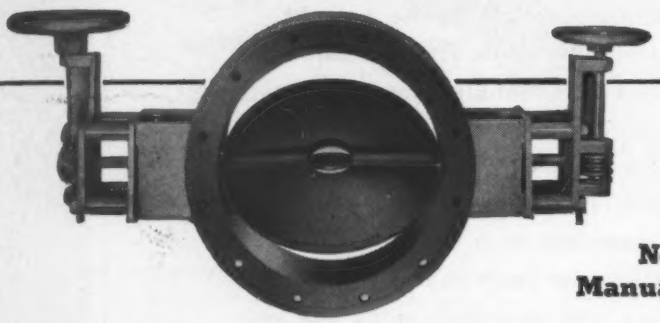

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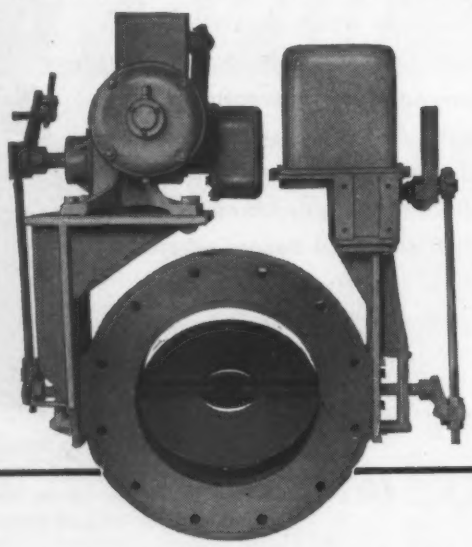

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600° C. Pitting and corrosion are therefore more likely to occur on short runs or during frequent starts and stops than in long-continued operation. Lead bromide attacks even the special austenitic valve steels. If the valve runs hot enough to be covered with a film of molten lead bromide, the effect of prolonged heating is to drive off the bromine and allow lead oxides to be deposited on the steel. Such deposits gradually build and finally allow the escape of hot exhaust gases, the action of which is erosive and corrosive. A high-carbon, high-chromium steel is suggested as best, e.g., one containing approximately 13 percent of chromium and 1.1 to 1.2 percent of carbon. Chromium carbide is chemically inert.

Petroleum Solvents, E. M. Toby, Jr., *Ind. & Eng. Chem.* **35** (1943) pp. 1044-7.

Although petroleum "solvents" are in some cases true solvents, they are more often thinners, extenders, and diluents. They can be defined as "a homogeneous mixture of paraffinic, naphthenic, and aromatic hydrocarbons of different boiling points." Limitless in number as are all mixtures, they are usually defined by their controlled evaporation rates. Three general classes of petroleum solvents are discussed by the author: (1) straight-run solvents, predominantly paraffinic but sometimes cycloparaffinic in structure, (2) aromatic solvents, containing from 45 percent aromatics to pure nitration grades, and (3) close-cut hydrocarbons, primarily hexane and heptane with 5° to 15° F. boiling ranges. The specifications for standard aliphatic and naphthenic solvents are given for fourteen solvents, including light and intermediate lacquer diluents, rubber solvents, special extraction solvents, heavy lacquer diluents, V. M. & P. naphthas, mineral spirits, toluene and xylene replacement naphthas, high-flash mineral spirits, high-flash dry cleaning solvent and paint thinner, flat-finish thinner, and slow-dry thinner. In another table the uses of aliphatic and naphthenic solvents are given, and the solvents used for the purposes listed are indicated. Specifications of aromatic solvents from petroleum are tabulated for six solvents including toluene replacement, light xylene replacement, heavy xylene replacement, mineral spirit replacement, medium boiling solvents, and high boiling solvents. Specifications of close-cut petroleum solvents are also tabulated for six products, including technical n-hexane, commercial n-hexane, technical n-heptane, commercial heptane, technical cyclopentane, and technical methylcyclopentane. After the war the use of aromatic solvents will increase greatly because of increased availability to conversion to solvent manufacture of plants built for other war purposes. New close-cut solvents will also be made, as well as new types of deodorized naphthas and naphthas of specific chemical structures.

Coal Tar Solvents, F. E. Cislak, *Ind. & Eng. Chem.* **35** (1943) pp. 1020-22.

Coal tar solvents are composed of neutral, acidic, and basic cyclic compounds characterized by the presence of a six-membered ring in the molecule. They are all soluble in most of the common organic solvents. Some are insoluble in water; others are miscible with water in all proportions. They may conveniently be grouped into three classes—hydrocarbons, oxygen-contain-

Don't get left

Refiners who put off their post-war planning too long are likely to be left at the post—or at least, not to be in at the finish

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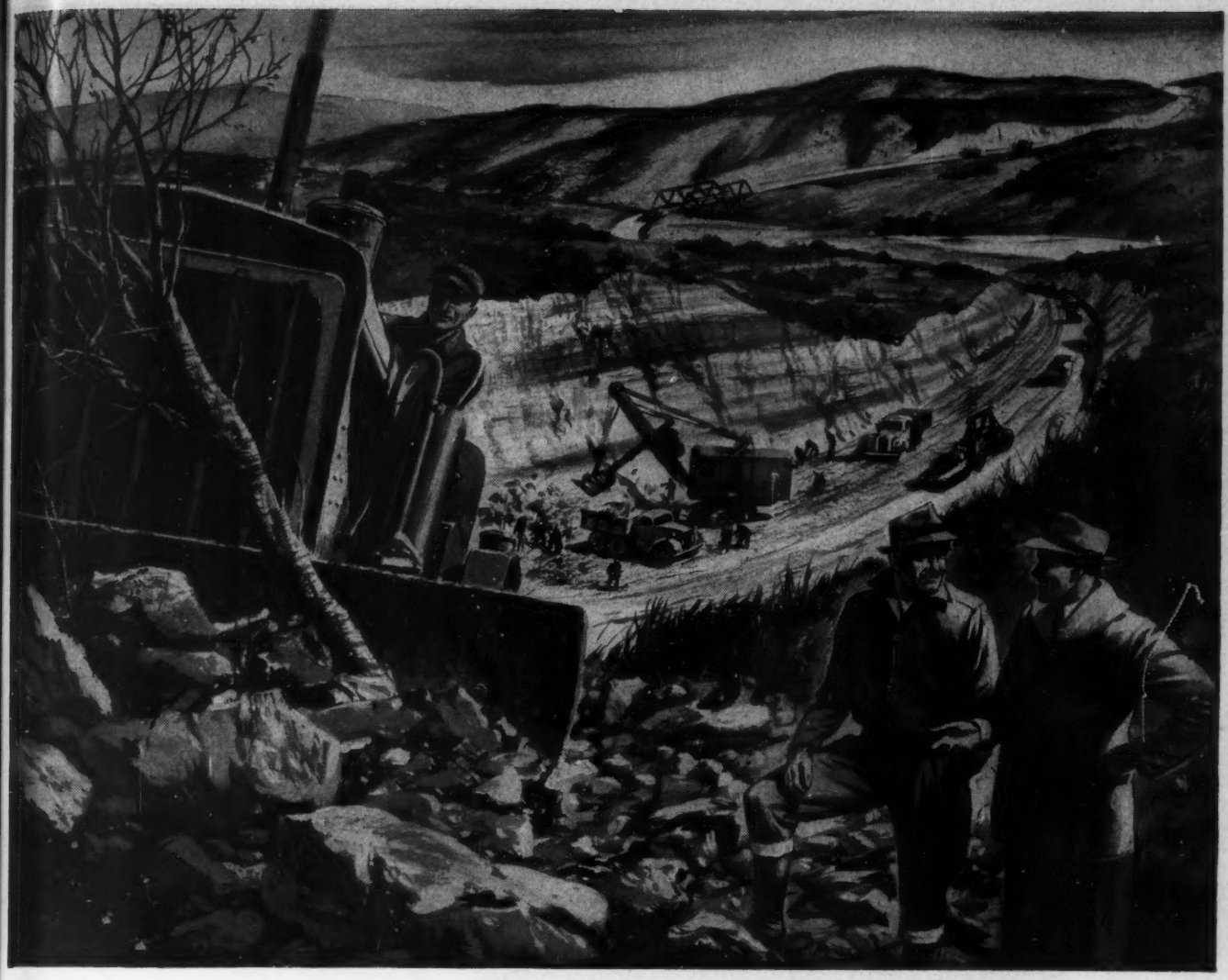
ing compounds, and nitrogen-containing compounds. Among the hydrocarbons described in the article are benzene, toluene, xylene, solvent naphthas, cyclohexane, and methylcyclohexane, tetralin, decalin, methylnaphthalene, dimethylnaphthalene and amylnaphthalene. Among the oxygen-containing compounds included are phenol, cresols, cyclohexanol and methylcyclohexanol, and xylenols. Amont the nitrogen-containing compounds included are pyridine, a-picoline, denaturing-grade pyridine, and quinoline. In each instance the common physical properties are given and some mention is made of the uses of the solvent.

Stability of Furnace Oil, A. B. HERSBERGER, H. C. COWLES, AND B. ZIEBER, *Ind. & Eng. Chem.* **35** (1943) pp. 1104-7.

The extensive use of furnace oil for domestic heating has placed new demands on quality. The criteria of performance are a clean burning flame and uninterrupted automatic operation. The literature of the subject is briefly reviewed. The fouling of domestic burner systems by unstable furnace oils is discussed. A stability test is described, and data are presented relating this test to results obtained by circulating oils through the essential parts of a gravity-feed burner system. Results so obtained were found to correlate with practice. Data on both refined and unrefined oils are included. The stability test is based on the reaction of oils to two metal pairs, iron-copper and iron-lead, under controlled conditions. The test was originally designed for straight-run oils. Its limitations with respect to cracked oils are pointed out. The stability test described has been used by the Atlantic Refining Company for three years as a means of controlling the quality of a domestic furnace oil under refining operations related to its production.

Surface Consistency Characteristics of Asphalts, E. C. KNOWLES AND F. C. McCOY, *Ind. & Eng. Chem.* **35** (1943) pp. 1118-22.

The need for studying the surface consistency characteristics of asphalts, as well as bulk flow properties, is noted. A modification of the A.S.T.M. asphalt penetration method, used to investigate consistency characteristics of asphalt surfaces ranging in thickness from 0.04 to 0.30 cm., is described. The modified procedure is based upon the load in grams required to force the A.S.T.M. needle into the asphalt to a given depth in a constant time. It avoids several shortcomings of the A.S.T.M. penetration procedure and is identified as constant depth penetration. Data are given to illustrate the application of constant depth penetration measurements to show the progressive increase of hardness of roofing asphalt in the accelerated weathering test. Data are also given to illustrate application of the method to the measurement of the effect of various storage conditions on surface consistency of asphalt, and from this work a storage test was chosen at 125° F. whereby the tendency of asphalts from various sources to undergo surface hardening was determined. The conclusion is reached that certain properties of asphalt surfaces can be studied by application of constant depth penetration measurements, and that the results supplement information currently obtained by bulk flow consistency measurements.



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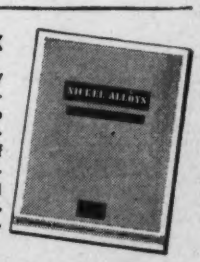

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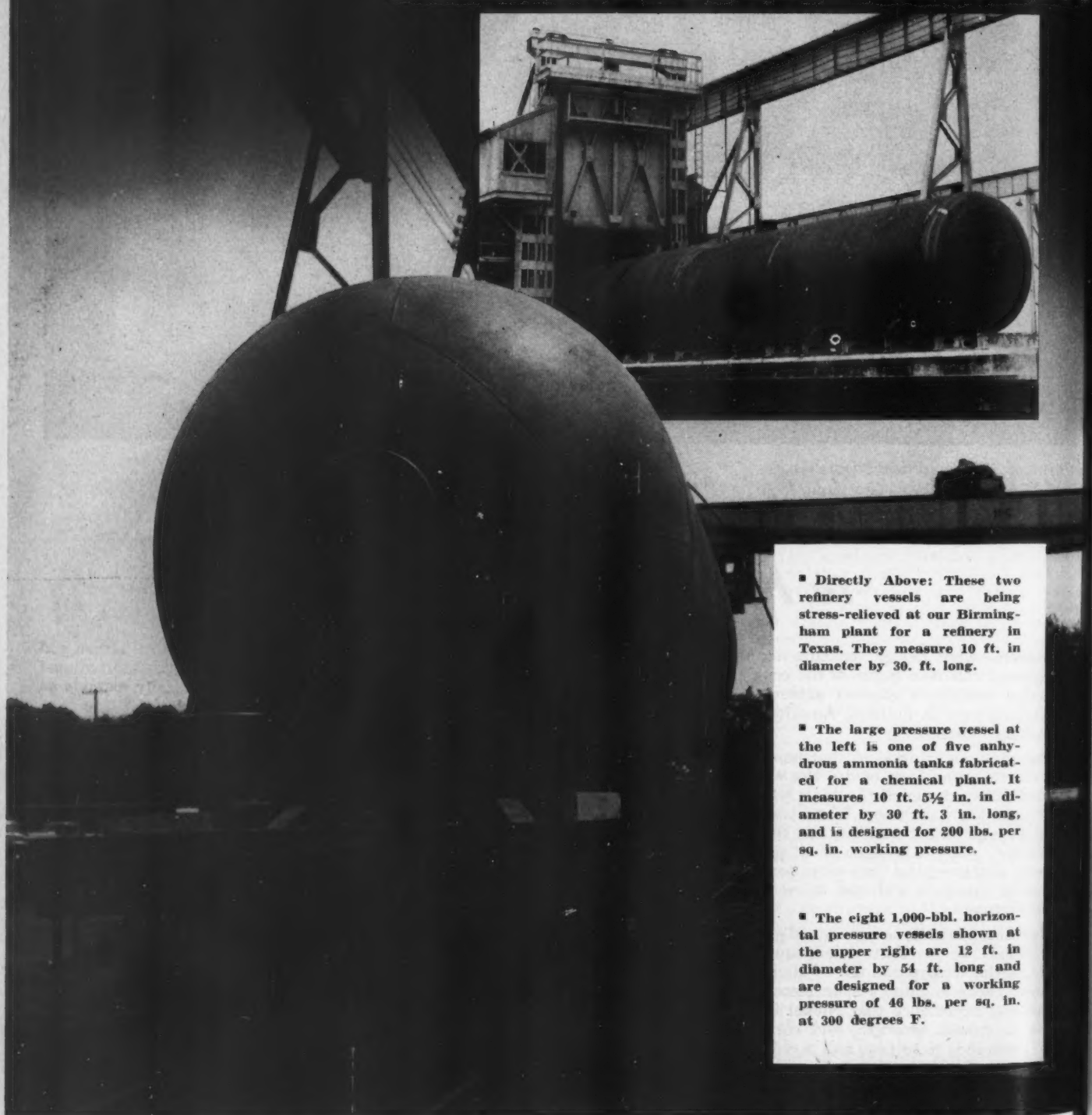
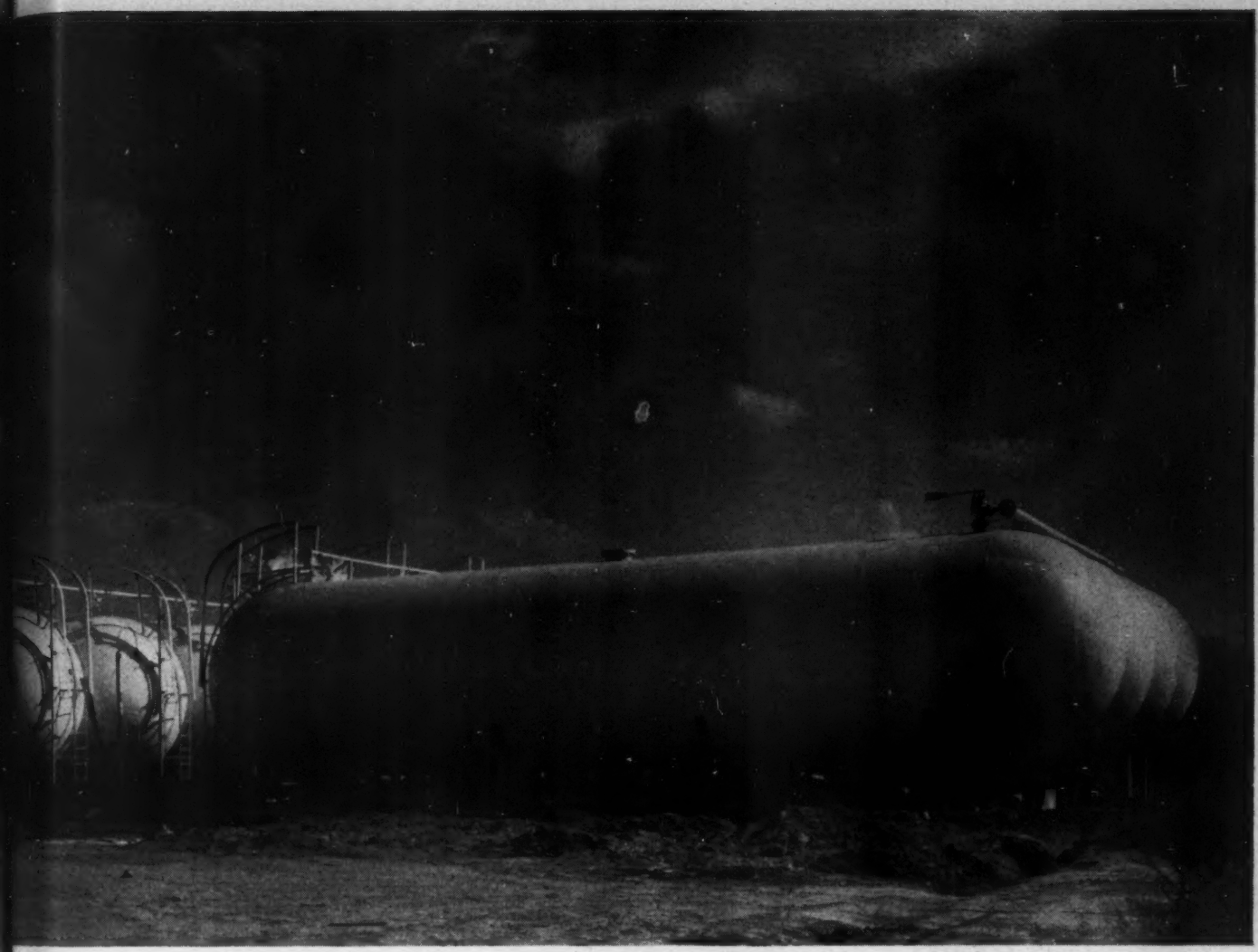


■ **Directly Above: These two refinery vessels are being stress-relieved at our Birmingham plant for a refinery in Texas. They measure 10 ft. in diameter by 30. ft. long.**

■ **The large pressure vessel at the left is one of five anhydrous ammonia tanks fabricated for a chemical plant. It measures 10 ft. 5½ in. in diameter by 30 ft. 3 in. long, and is designed for 200 lbs. per sq. in. working pressure.**

■ **The eight 1,000-bbl. horizontal pressure vessels shown at the upper right are 12 ft. in diameter by 54 ft. long and are designed for a working pressure of 46 lbs. per sq. in. at 300 degrees F.**



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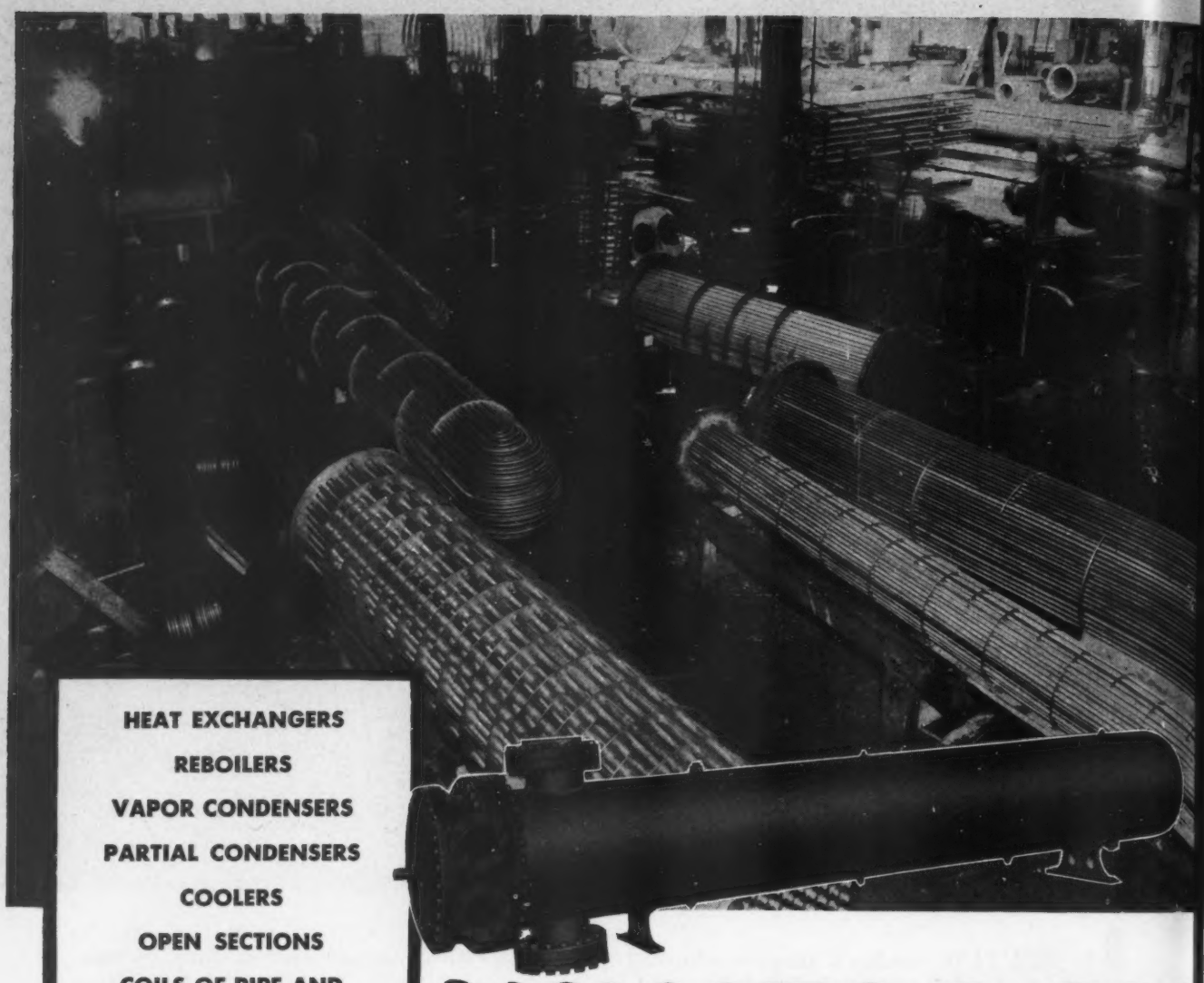
To cool or heat any liquid or gas . . . to condense any vapor . . .



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PARTIAL CONDENSERS
COOLERS
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COILS OF PIPE AND TUBING
PREFABRICATED PIPING
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The modern facilities of Solvay's new potash plant—which include the most efficient types of equipment, are especially designed to meet your wartime requirements for high grade caustic potash. From its broad background of experience as America's largest producer of Soda Ash, Caustic Soda and other important alkalies, Solvay has developed both men and facilities to produce potash materials with an *absolute minimum of impurities!*

★ Solvay Caustic Potash Liquor (shipped in tank cars) —has KOH content of approximately 50%.

★ Solvay Caustic Potash in the dry form contains a minimum of 90% KOH.

★ **LIQUOR**
(45-50% KOH)
Shipped in tank cars—10,000 gallons.

★ **SOLID**
(90% minimum KOH)
Shipped in steel drums—700 lbs.

★ **FLAKE**
(90% minimum KOH)
Shipped in steel drums—350 lbs.

Solvay can meet your requirements . . . Write today!

SOLVAY SALES CORPORATION
Alkalies and Chemical Products Manufactured by The Solvay Process Company
40 RECTOR STREET NEW YORK 6, N. Y.

BRANCH SALES OFFICES:

45 Milk Street	Boston 9, Mass.
212 South Tryon Street	Charlotte 2, N. C.
1 North LaSalle Street	Chicago 2, Ill.
3008 Carew Tower Building	Cincinnati 2, Ohio
926 Midland Building	Cleveland 15, Ohio
7501 West Jefferson Avenue	Detroit 32, Mich.
1101 Hibernia Building	New Orleans 12, La.
40 Rector Street	New York 6, N. Y.
12 South 12th Street	Philadelphia 7, Pa.
1107 Gulf Building	Pittsburgh 19, Pa.
3615 Olive Street	St. Louis 8, Mo.
Milton Avenue	Syracuse 1, N. Y.

JERGUSON

GAGING

for whom... one of the largest Synthetic Rubber plants in the country.

on what... on about twenty different pieces of processing equipment including tanks, stock line tanks, decanters, pump cushion chambers, and receivers.

with what... with Jerguson Reflex and Transparent Gages.

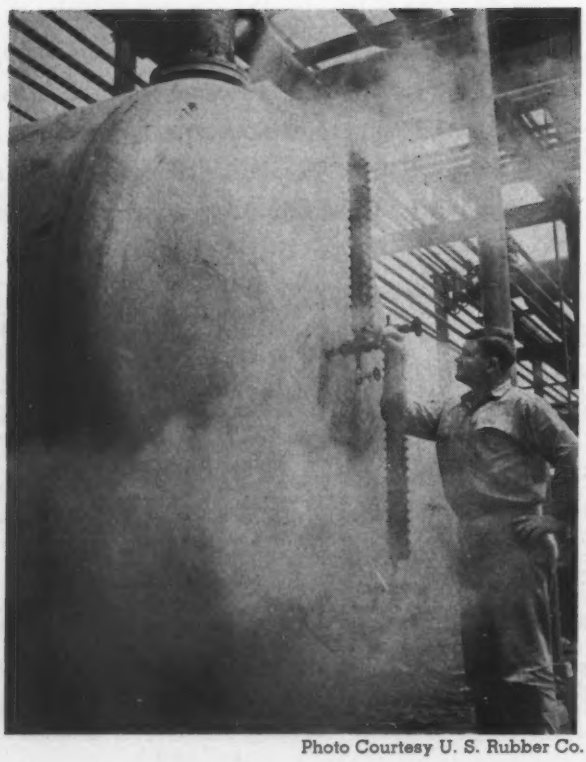


Photo Courtesy U. S. Rubber Co.

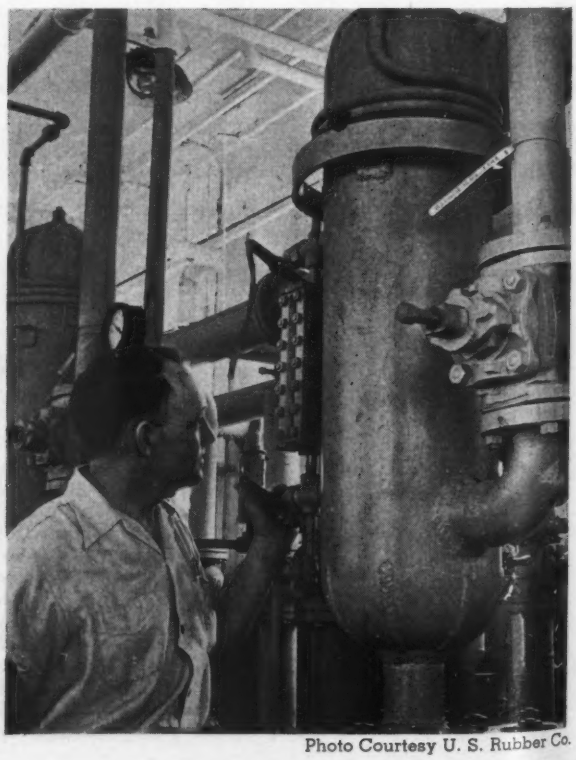


Photo Courtesy U. S. Rubber Co.

LIQUID LEVELS

When every link in a chain is strong, the chain itself is strong. The same is true of equipment installed for carrying out a process . . . synthetic rubber, for example.

In a synthetic rubber plant there are numerous places where it is important that *readable and durable* liquid level gages be used. They are links in that chain stretching from raw materials to finished products. They must be good.

Jerguson Gages are serving many process plants just as they are serving in the synthetic rubber plant, as illustrated below. Reflex and Transparent Gages are made to take care of all requirements of pressure, temperature and corrosion.

Jerguson Gage and Valve Co.

87 FELLSWAY **SOMERVILLE 45, MASS.**

REPRESENTATIVES:

Desco Corporation
2nd and Welsh Sts., Chester, Pa.

Associated Valve & Engineering Co.
510 North Dearborn St.,
Chicago, Ill.

W. D. Emery Co.
1015 McBirney Building,
Tulsa, Oklahoma

O'Brien Equipment Co.
2832 Olive St.,
St. Louis, Mo.

Bushnell Controls & Equipment Co.
(All of California)
117 West Ninth St.,
Los Angeles, Calif.

H. R. Bowers
1758 Wright Ave.,
Cleveland, Ohio

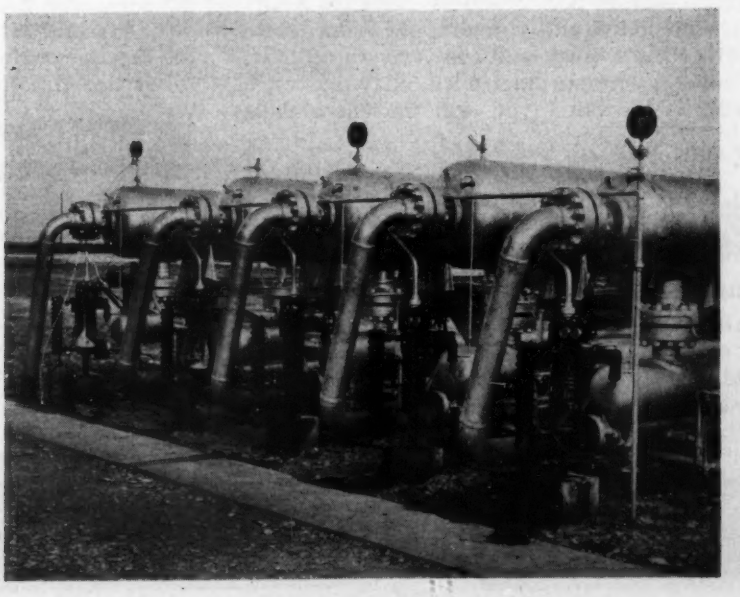
J. Arthur Moore
342 Madison Ave.,
New York, N. Y.

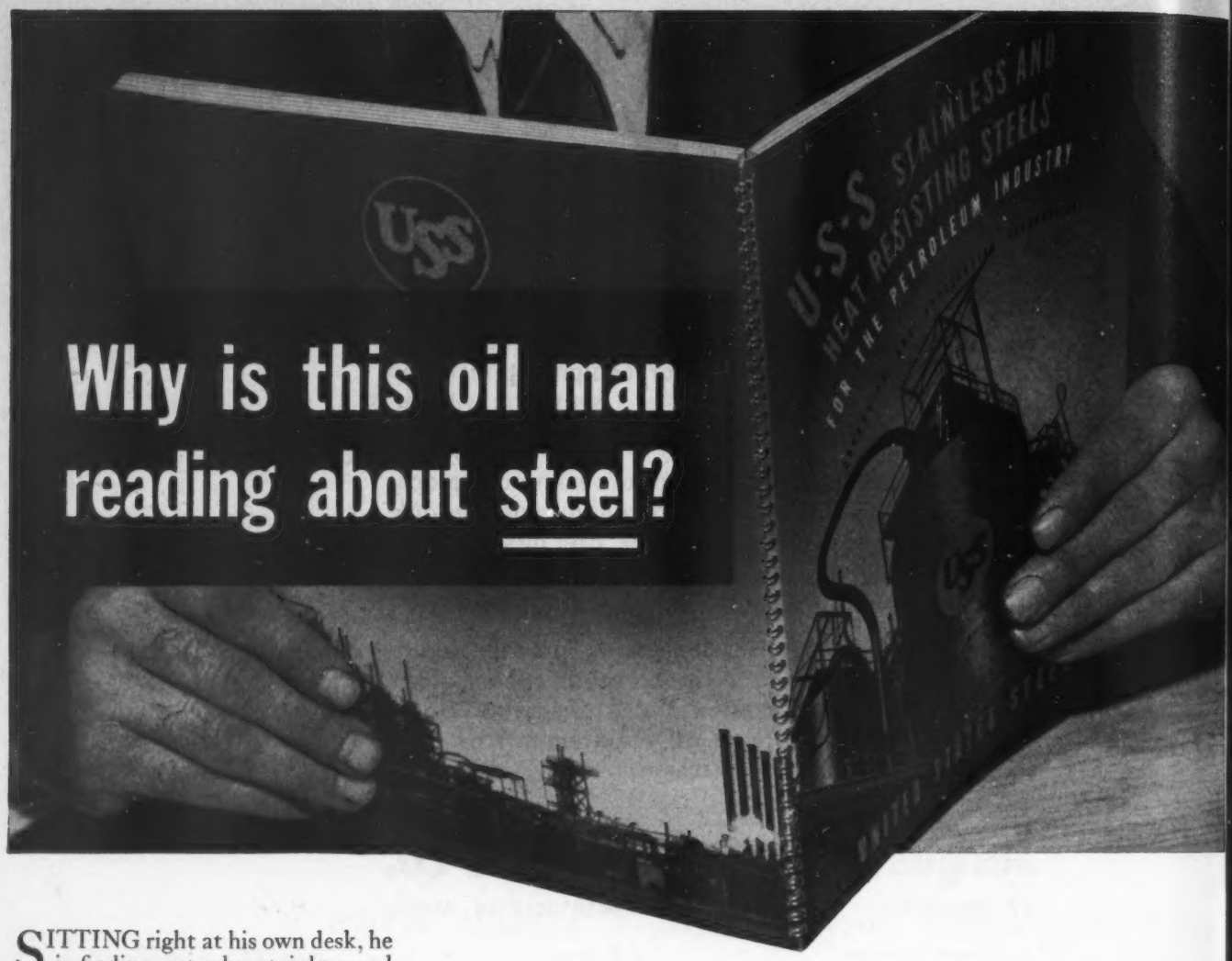
The J. A. Rossiter Co.
Houston, Texas

Murray-Baker-Frederic, Inc.
620-630 S. Peters St.,
New Orleans, La.

Paul B. Huyette Co., Inc.
401 North Broad St.,
Philadelphia, Pa.

12-JV-1





Why is this oil man reading about steel?

SITTING right at his own desk, he is finding out why stainless and heat-resisting steels help hundreds of refiners to boost their output of quality products to new high records and also to cut costs to the bone.

He has long known that different metals have varying success in their conflict with the enemy reagents encountered in processing all grades of crude. He sees now how refinery engineers and our steel specialists—working side by side—developed stainless steel refinery equipment that resists heat, pressure and corrosion, prevents coking and fouling, stays on stream for longer runs, assures more accurate, more rapid fractionation and reduces cleaning time as much as 90%. He realizes that these steels made possible the development of fine big cat crackers that wring the last drop of 100 octane gas out of each barrel of crude.

It will pay you to check up, to make sure that your refinery is taking full advantage of all the qualities of U·S·S Stainless Steel in all its many and varied applications. Here is a quick and easy way to do that.

In our fact-filled, fifty-one page brochure, you will find invaluable engineering, cost and performance data, charts, graphs and explanatory text in your own language. Generously illustrated, with dozens of photographs of actual stainless installations and many drawings, the brochure is yours for the asking.

All you have to do is fill in and mail the convenient coupon — or write to us on your company letterhead — and your copy of "U·S·S Stainless and Heat Resisting Steels for the Petroleum Industry" will be forwarded to you by return mail.

Steel needs more scrap NOW . . . *send it in!*

U·S·S Stainless Steel

SHEETS · STRIP · PLATES · BARS · BILLETS · PIPE · TUBES · WIRE · SPECIAL SECTIONS

AMERICAN STEEL & WIRE COMPANY, *Cleveland, Chicago and New York*
CARNEGIE-ILLINOIS STEEL CORPORATION, *Pittsburgh and Chicago*
COLUMBIA STEEL COMPANY, *San Francisco*
NATIONAL TUBE COMPANY, *Pittsburgh*
United States Steel Supply Company, Chicago, *Warehouse Distributors*
United States Steel Export Company, New York

SEND NO MONEY · IT'S FREE!

United States Steel Corporation Subsidiaries
Room 621, Carnegie Building
Pittsburgh 30, Pa.

Dear Sirs:

Please send along my copy of *"U·S·S Stainless and Heat Resisting Steels for the Petroleum Industry"*. It is fully understood that I incur no obligation.

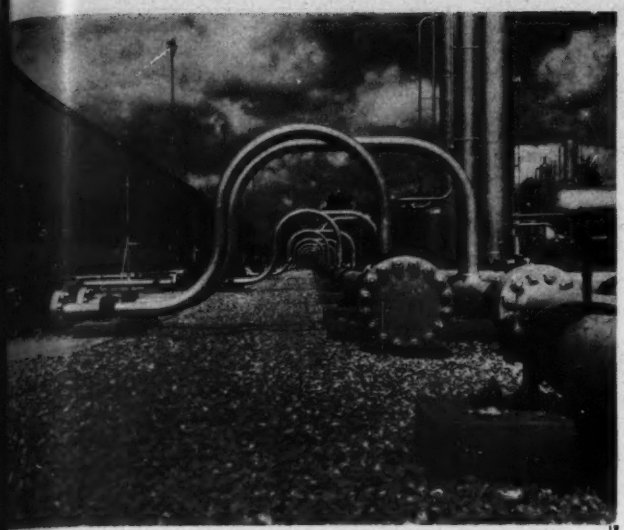
Name.....

Street & Number.....

City..... State.....

P.R. 1265

UNITED STATES STEEL



Prefabricated pipe bends for high pressure service shown on location

37 YEARS EXPERIENCE

In Exacting Pipe Fabrication

TEXAS
PIPE BENDING
COMPANY
Pipe Fabricators

301 Frio St. HOUSTON, TEXAS Woodcrest 6-2659

Designed for high head—high temperature service.

FOR PUMPING

Butane... Styrene... Butadiene... Iso-Butane... Benzol... Toluol... etc.

HIGH PRESSURES — Single, multivaned impeller at normal speeds develops extremely high pressures in single stage.

LOW NPSH REQUIREMENT — Lower pressure drop (suction loss) is an outstanding characteristic. Assures satisfactory operation under minimum head conditions.

ONE LOW-PRESSURE STUFFING BOX — Subjected to suction pressure **only** — not to discharge pressure. Minimizes chance for leakage. Ideal for volatile liquids.

ONLY 1 ROTATING PART — Impeller rotates freely **without** frictional contact.

FREE DATA BOOK. Write on your business letterhead for FREE 144 page book! Address: Dayton-Dowd Company, Dept. P-8, Quincy, Illinois.

DAYTON-DOWD
Turbine Pumps
Centrifugal Pumps

PROTECTING THE HEADS OF OUR VITAL WAR WORKERS

IN PETROLEUM REFINING ...AND IN SHIPYARDS... BRIDGE AND STEEL ERECTION... BUILDING CONSTRUCTION...MINING ...STEEL MILLS...CHEMICAL PLANTS AND MANY SPECIAL FIELDS

M·S·A

Skullgards

Peacetime's most popular work hat is doing a *bigger* job in war—answering the call for proved head protection in every stepped-up industry where head hazards threaten—saving priceless man-hours for higher war production. M.S.A. Skullgards interpose the strength of laminated bakelite between danger and the worker's head—do not soften or deteriorate from exposure to water, oil, heat or ordinary chemicals, and are non-conductive to electricity. See for yourself their light-weight *comfort*—write for a demonstration!

For outstanding production achievement . . . the Maritime "M" Pennant and Victory Fleet Flag, awarded to M.S.A. by the U. S. Maritime Commission.

MINE SAFETY APPLIANCES COMPANY
Braddock, Thomas & Meade Sts., Pittsburgh, Pa.
District Representatives in Principal Cities

SERVICE	BRAND	TEMP. Use Limit	MORTAR USED	
			HIGH BOND	AIR SEAL AND CUSHION JOINT
EXTREME SERVICE Heavy Loads	**B&W 80** Firebrick	3000 F.	**B&W** Air Set Mortar	**B&W** High-Temperature Mortar
MODERATE TO SEVERE SERVICE where fireclay brick fail quickly, due to temperature, load or both	**B&W** Junior Firebrick	2850 F.	**B&W** Air Set Mortar	**B&W** High-Temperature Mortar
INSULATING EFFECT	**B&W**		**B&W**	**B&W**
	K–20	2000 F.	Smoothset Mortar	K20 Clay
	K–23	2300 F.	Smoothset Mortar	IFB Mortar
	K–26	2600 F.	Smoothset Mortar	IFB Mortar
	K–28	2800 F.	Smoothset Mortar	IFB Mortar
	K–30	2900 F.	Air Set Mortar	IFB Mortar
	Insulating Firebrick			

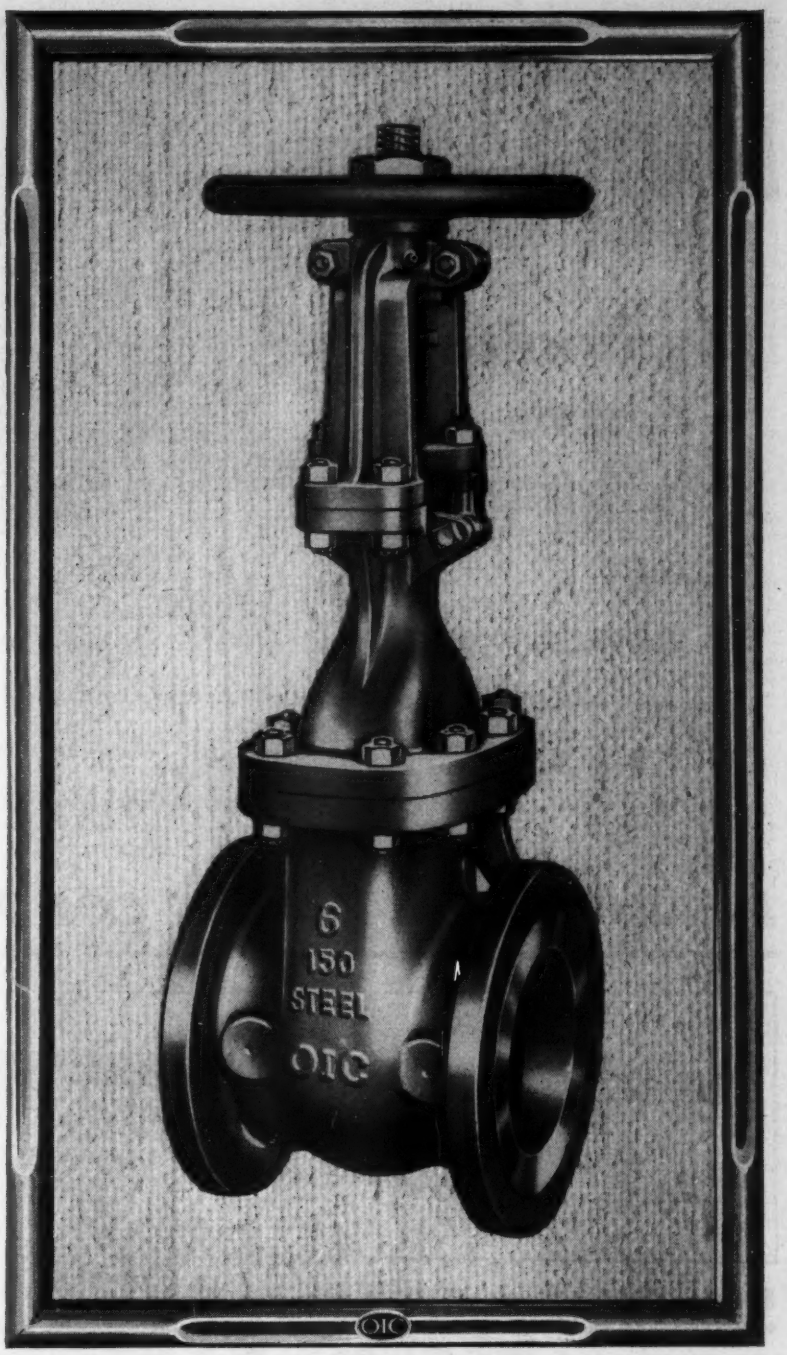
R-168

The Company's engineers will be glad to supplement this elementary guide with recommendations on special applications or for unusual requirements of B&W Refractories.

BABCOCK & WILCOX

THE BABCOCK & WILCOX COMPANY
Refractories Division • 85 Liberty St. New York 6, N. Y.

Look to OIC for STEEL VALVES



For today's critical needs and for tomorrow's planning, look to OIC for CAST STEEL VALVES — worthy additions to the 60-year old line of famous, sturdy OIC Bronze and Iron Valves.

There is an OIC Distributor near you. Call him. Or write us for information.

ARMY E NAVY

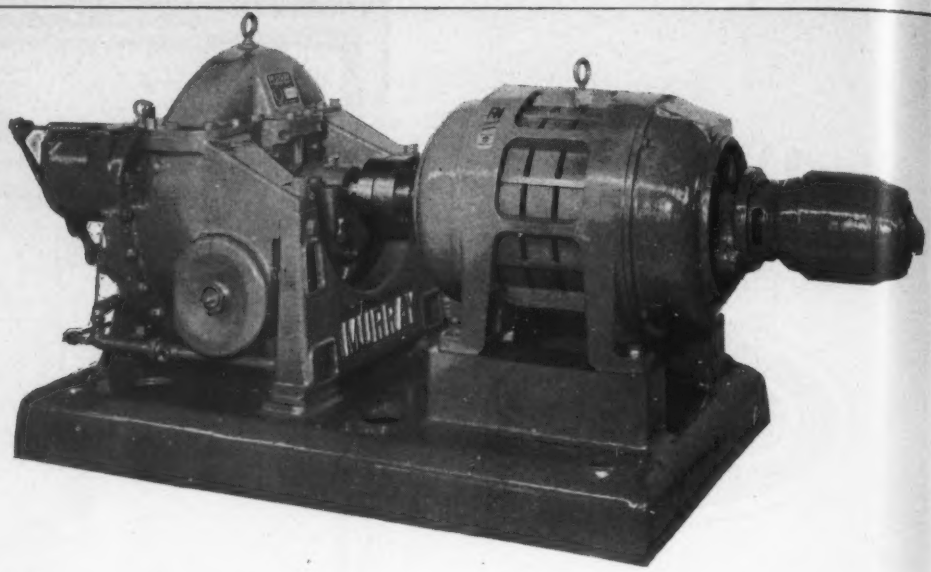
OIC

THE OHIO INJECTOR COMPANY
WADSWORTH, OHIO
Quality Leaders in Valve Manufacture Since 1883

MURRAY

TYPE "U"

Mechanical Drive Turbines



Murray Type "U" Mechanical Drive Turbines are adaptable to a variety of drives. View shows Type "U" turbine directly connected to a 20 K.W. alternating current generator operating at 1800 R.P.M. The unit is installed in a large oil refinery in Venezuela where the turbine supplies exhaust steam for process requirements.

MURRAY IRON WORKS COMPANY, Burlington, Iowa

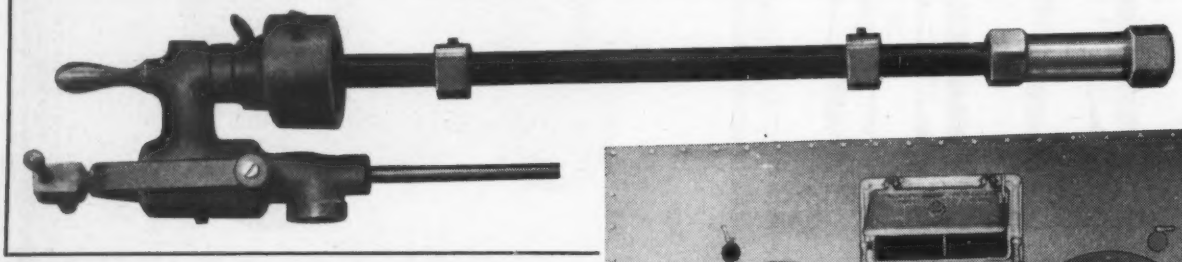
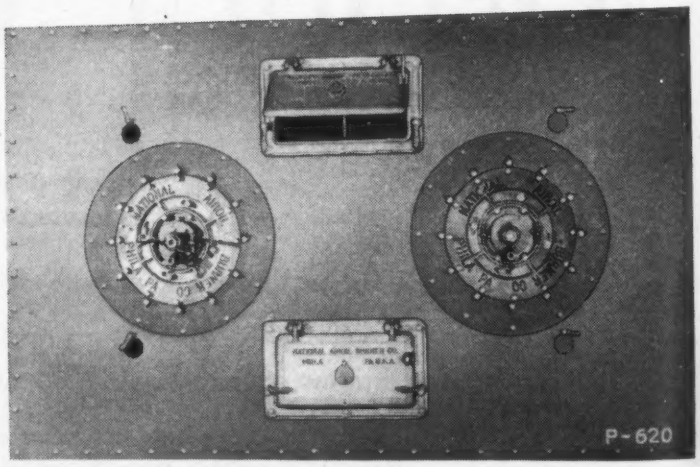


Fig. No. 1630



SATISFACTION prompted Order No. 3

Two Universal Registers, shown at the right, installed in the forced draft wind box of a 70,000 pounds per hour high pressure steam generator for use with

NATIONAL AIROIL

MECHANICAL ATOMIZING OIL BURNERS

is the third similar installation ordered from us by one user. The original had given such complete satisfaction with regard to fuel efficiency, ease of regulation and low maintenance, that repeat orders were the logical solution to the need for increased capacity.

The Type M A Mechanical Atomizing Burner is provided for those installations where it is necessary to atomize solely by means of the fuel oil pressure. It has been time tested in a variety of applications. Can we tell you more about it?

NATIONAL AIROIL BURNER

OIL BURNERS • GAS BURNERS • GAS PILOTS • PUMP SETS
• EXPLOSION DOORS • ACCESS DOORS • AIR DOORS
• BURNER BLOCKS • FURNACE OBSERVATION WINDOWS

COMPANY, INCORPORATED
1254 East Sedgley Avenue
PHILADELPHIA 34, PENNA.

OIL . . . from Earth to Air through KEROTEST VALVES

Series 300 cast steel flanged end Globe Valve
Series 150 cast steel screw down Angle Check Valve
Series 1500 cast steel flanged end Gate Valve
KEROTEST

Fighting oil travels through Kerotest Valves from the well to the refinery, and throughout its processing into America's (and the world's) finest aircraft-quality gasolines. At every control point on the way, Kerotest Valves are doing a faultless job for all of us.

KEROTEST MANUFACTURING COMPANY
PITTSBURGH, PENNSYLVANIA

★ PUMPS ★ ★ ★ ★

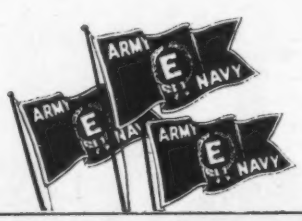
FOR THE HOUDRY PROCESS

The Houdry catalytic process is an important factor in the production of the tremendous quantities of 100-octane aviation gasoline used in our war effort.

It was found that an entirely new type of pump was required for the process. Ingersoll-Rand was requested to develop a suitable pump by the engineers of the Houdry Process Corporation, Socony-Vacuum Oil Company, and E. B. Badger & Sons Company, who were collaborating in the design and construction of these plants.

The pumps were to handle a molten mixture of sodium and potassium nitrates and nitrites. The molten salt is used to control the catalytic reactions employed in the process. This salt mixture, which possesses no lubricating qualities, is used at a temperature of 800-850°F.

Ingersoll-Rand, whose engineers have had years of experience with pumps for the refinery field and for high temperature service, developed a vertical pump with axial and centrifugal flow characteristics. Today practically all Houdry plants are equipped with Ingersoll-Rand hot salt pumps. They have been developed in sizes from 10 to 600 hp. to meet the demands of different installations. The first of these pumps went into service more than four years ago. Their exceptional performance has resulted in many repeat orders. Ingersoll-Rand Company, Cameron Pump Division, 11 Broadway, New York 4, N. Y.



10-309

CENTRIFUGAL PUMPS • CONDENSERS • COMPRESSORS • TURBO BLOWERS • ROCK DRILLS • AIR TOOLS • OIL AND GAS ENGINES

Ingersoll-Rand

CHASE *Antimonial Admiralty*
CONDENSER TUBES

SS REAN *Admirable Choice*

re all the products of the manufacturers we esent. With adequate stocks at central points throughout the Mid-Continent and engineering experience for time saving assistance — put YOUR requirements up to VINSON SUPPLY COMPANY—

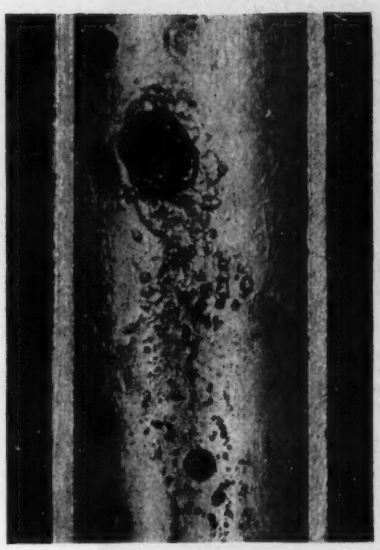
IDENTIFIED WITH THE *LEADERS!*

FISHER Automatic Controllers

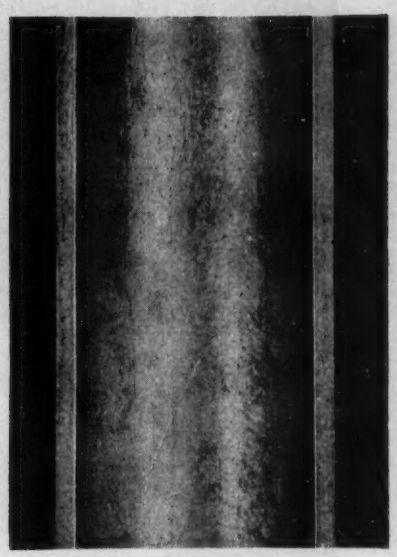
NATIONAL Pipe and Steel Tubes

TUBE-TURNS Tees, Reducers, Flanges and Welding Caps

CHASE Standard Brass Products



PLAIN ADMIRALTY
This Tube failed from dezincification.



ANTIMONIAL ADMIRALTY
This Tube still in good condition.

The tubes illustrated above were taken from the same heat exchanger bundle. Both were in service the same length of time.

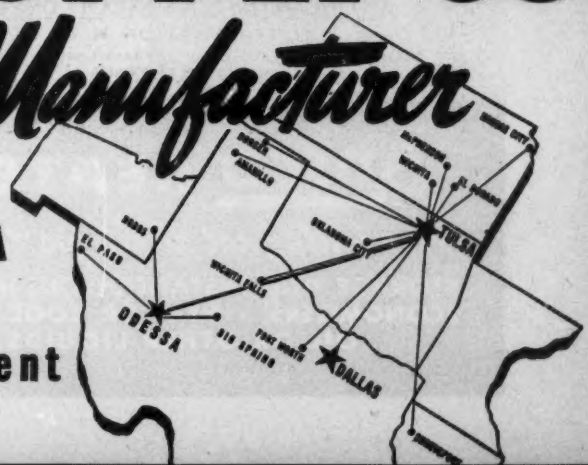
RESIST BOTH DEZINCIFICATION AND SULPHUR CORROSION

Always specify CHASE "Antimonial Admiralty" Condenser Tubes for new Heat Exchangers and Condensers . . . at no extra cost they will insure construction to withstand maximum corrosion.

Supply Headquarters for the Refiner

VINSON SUPPLY CO

and Natural Gasoline Manufacturer



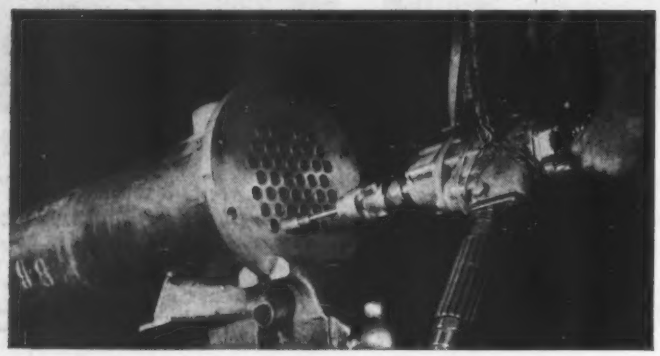
DALLAS • TULSA • ODESSA

Service That COVERS The Mid-Continent

ADSCO

builds HEATERS *that are*

Designed right



and built right

Whether you are interested in a heater for a building or a boat, let ADSCO design and build a unit that has the capacity, efficiency and reserve requirements exactly suited to your particular operating conditions.

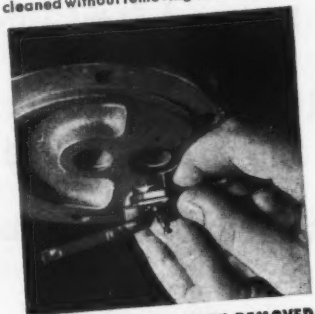
ADSCO has had over sixty years of experience in building heaters of various types and descriptions—horizontal or vertical—storage or instantaneous—heat economizers and special equipment to heat or cool water, oil or other liquids. This is why America's largest industries, ship builders—institutions—Army and Navy look to ADSCO for heaters. Submit the details of your heating or cooling problems to us, or write for bulletin No. 35-75 R.

AMERICAN DISTRICT STEAM COMPANY
N. TONAWANDA, N. Y.
MAKERS OF "UP-TO-DATE" STEAM LINE EQUIPMENT
FOR OVER 60 YEARS

ADSCO HEATERS
Are built just right for the job
STORAGE AND INSTANTANEOUS HEATERS
ECONOMIZERS · HEAT OR COOL WATER
OIL OR OTHER LIQUIDS

SUPER-SILVERTOP STEAM TRAP INSTALLED WITH SIMPLIFIED PIPING
either straight-in-line or as an elbow.. saves fittings...saves installation time.

EXCEPTIONAL ACCESSIBILITY
Super-Silvertops can be inspected and cleaned without removing from the line.



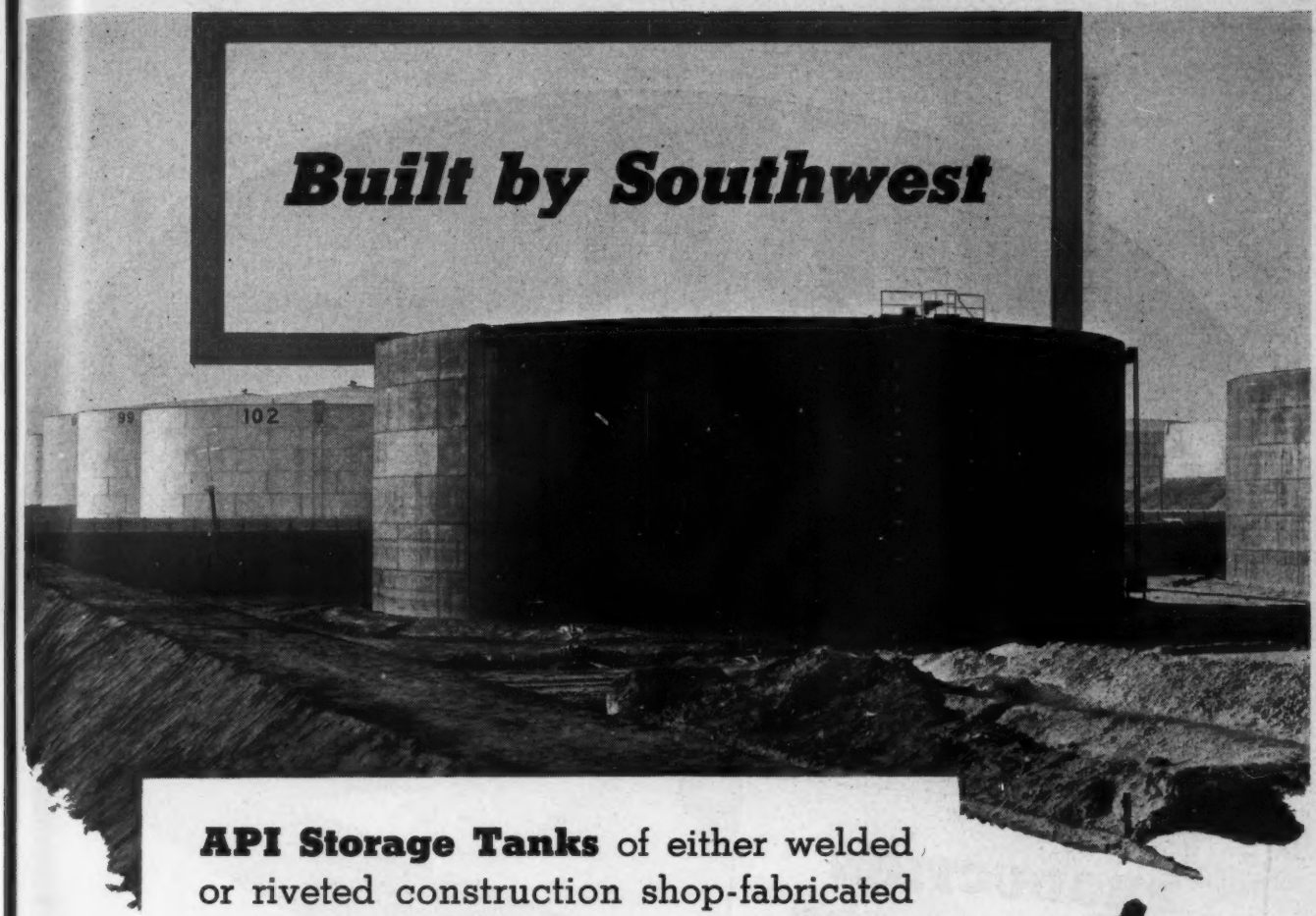
VALVE AND SEAT EASILY REMOVED
only a screwdriver is necessary to remove valve and seat.

Here's the "SUPER" *in Super-Silvertop Steam Traps*

● Add to the above advantages a trap of modern design and construction . . . built of heat-treated stainless steel and Anderloy . . . a trap that cannot airbind . . . that is truly self-cleaning . . . that works on either vacuum or pressure, hence cannot leak . . . and you have the SUPER quality that makes Super-Silvertop the streamlined Steam Trap designed for tomorrow's most exacting requirements. Let us send you a copy of the book, "How to Choose a Steam Trap," containing complete detailed information.

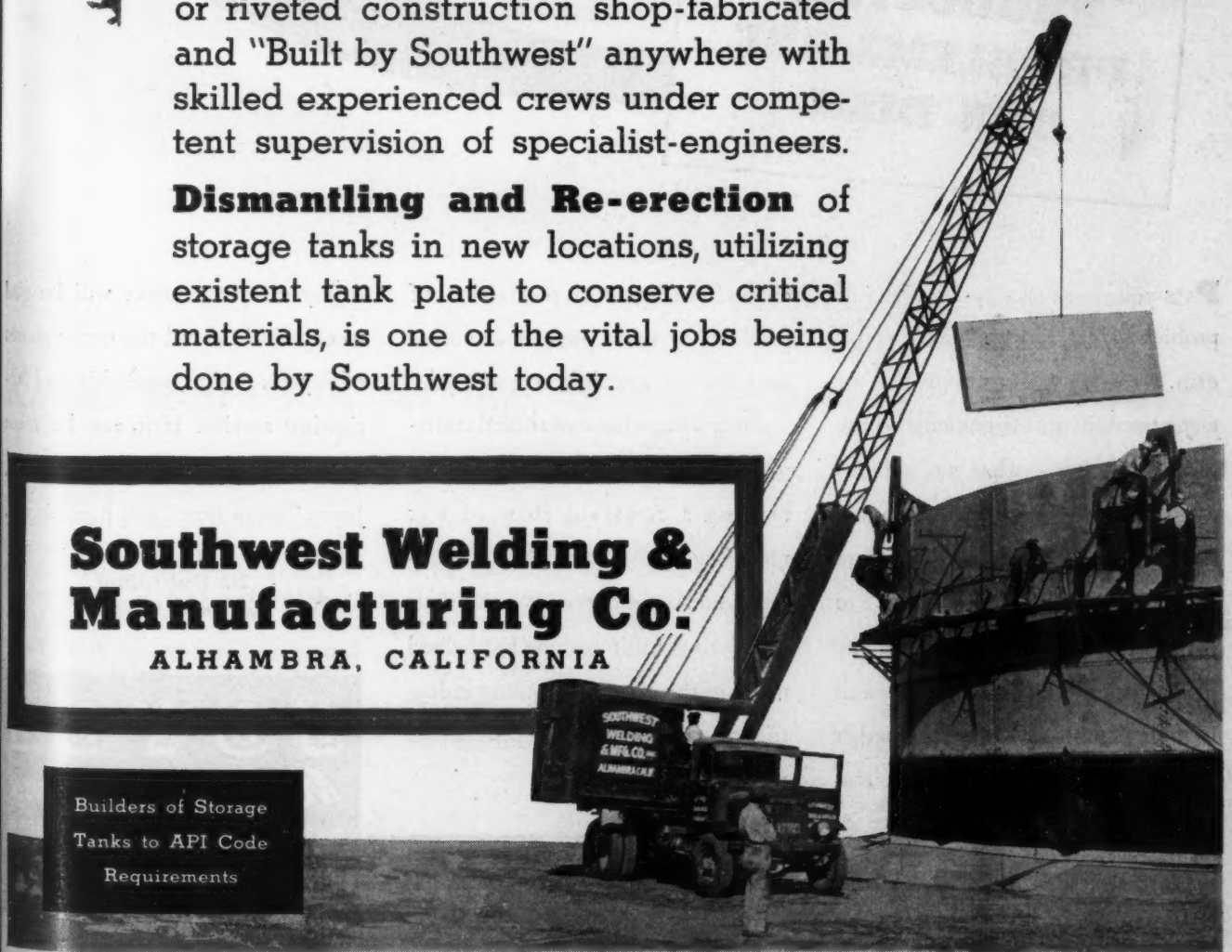
THE V. D. ANDERSON CO.
1942 West 96th Street · Cleveland, Ohio

Built by Southwest



API Storage Tanks of either welded or riveted construction shop-fabricated and "Built by Southwest" anywhere with skilled experienced crews under competent supervision of specialist-engineers.

Dismantling and Re-erection of storage tanks in new locations, utilizing existent tank plate to conserve critical materials, is one of the vital jobs being done by Southwest today.



Southwest Welding & Manufacturing Co.

ALHAMBRA, CALIFORNIA

Builders of Storage Tanks to API Code Requirements

PRODUCTION PROBLEMS ARE OUR DISH

PASS your hard-to-solve production problems along to Joyce—they're our dish. We don't wish to imply that we *prefer* the difficult assignments to the run-of-mill jobs—what we want to establish is that we've had such broad experience in production procedure and product improvement that we're confident we can help you materially in meeting your war contracts—and in your postwar planning. Whether it be the designing of special machines or the quantity production of products or parts, Joyce's extensive facilities are available to assist you.

Joyce's huge force of skilled craftsmen have proved themselves in maintaining a constant flow of war materials for the Army, Navy, Maritime and Aircraft services—and their ability to get things done has helped many of the country's leading industrial plants score enviable production records.

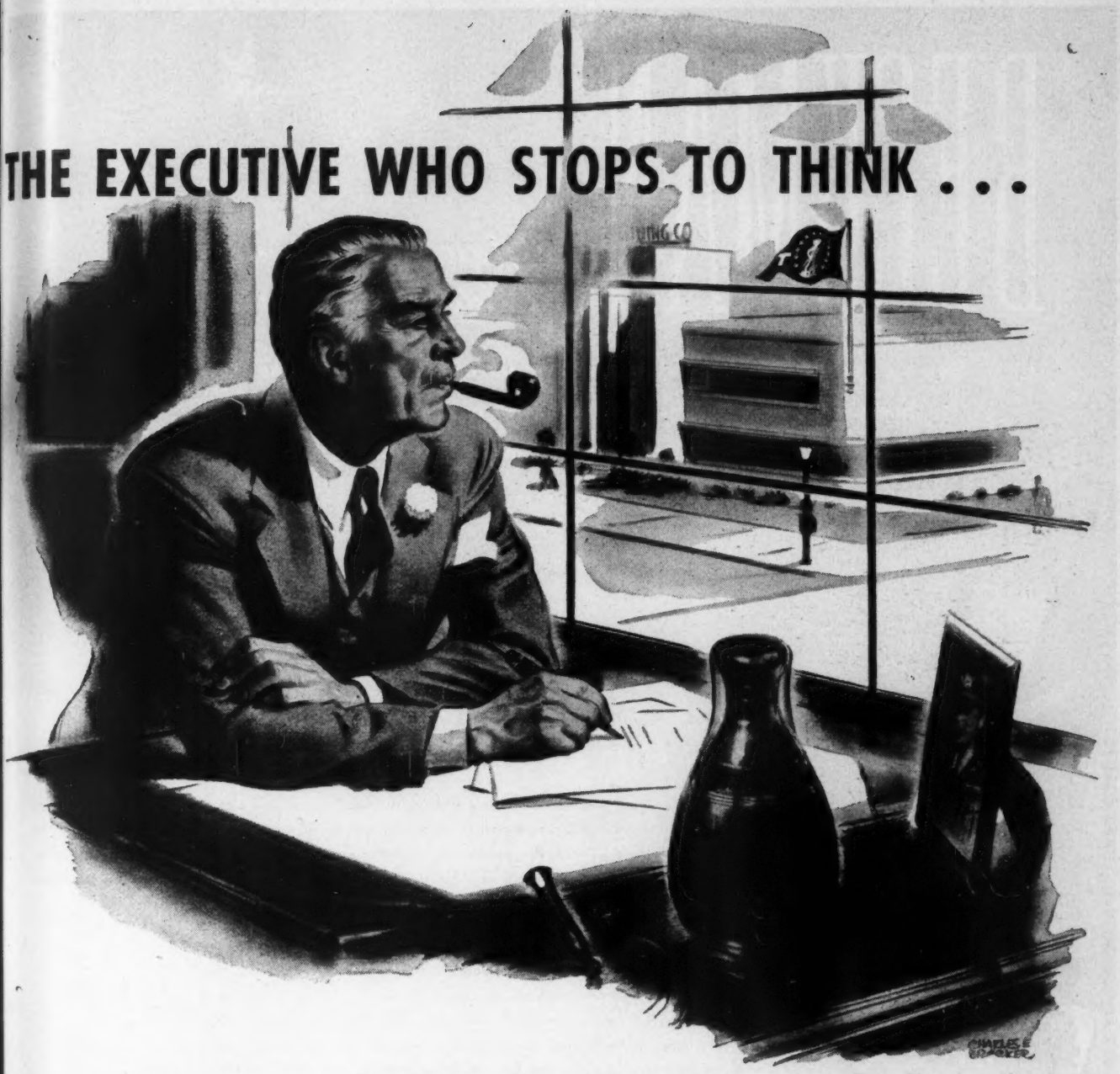
A Joyce representative will be glad to explain in detail the many phases of Joyce's design, assembly and fabricating service. If it can be made better, faster, more economically, Joyce "know how" will find the way.

★ *Hit Hitler Hard*
Buy Bonds for Bombs

JOYCE
Machine Company
WHEATSHEAF LANE • FRANKFORD • PHILADELPHIA
★
MANUFACTURERS OF PRECISION PARTS
FOR ALL KEY INDUSTRIES

BEHIND THE MAN ▶ BEHIND THE MAN ▶ BEHIND THE GUN

THE EXECUTIVE WHO STOPS TO THINK . . .



Knows that "10% for War Bonds isn't enough these days"

Workers' Living Costs going up . . . and Income and Victory Tax now deducted at source for thousands of workers . . .

Check! You're perfectly right . . . but all these burdens are more than balanced by *much higher* FAMILY INCOMES *for most of your workers!*

Millions of new workers have entered the picture. Millions of women who never worked before. Millions of others who never began to earn what they are getting today!

A 10% Pay-Roll Allotment for War Bonds from the wages of the family bread-winner is one thing—*a 10% Pay-Roll Allotment from each of several workers in the same family is quite another matter!* Why, in many such cases, it could well be jacked up to 30%—50% or even more of the family's *new* money!

That's why the Treasury Department now urges you to revise your War Bond *thinking*—and your War Bond *selling*—on the basis of *family* incomes. The current War Bond campaign is built around the family unit—and labor-management sales programs should be revised accordingly.

For details get in touch with your local War Savings Staff which will supply you with all necessary material for the proper presentation of the new plan.

Last year's bonds got us started—*this year's bonds are to win!* So let's all raise our sights, and get going. If we all pull together, we'll put it over with a bang!

This space is a contribution to America's all-out war effort by

PERTOLEUM REFINER

you've done your bit
. . . now do your best!

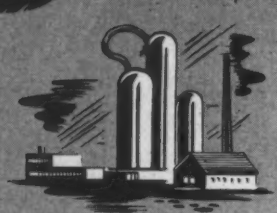
★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★

BECKMAN

the Name to Remember for Advanced Instrumentation

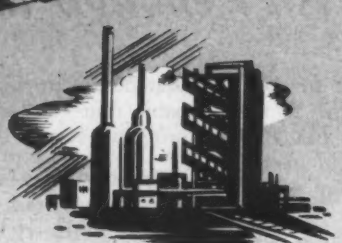
Step by step, as chemical industries have perfected new processes and new products to meet the needs of modern science, Beckman has pioneered *advanced* instruments to simplify the control of these processes . . .

▶ Beckman pioneered the first practical and portable glass electrode equipment for measuring pH. This development has become the foundation for the great modern advancements in pH control of industrial processes. It has made pH control simple, positive, accurate—enabling industry to step up production, reduce waste and make other important economies in production.



▶ Beckman developed the first *fully automatic* glass electrode pH indicator . . . the final link in pH control which enabled the advantages of the glass electrode to be applied to large-scale industrial processes on a completely automatic basis. Today this instrument is essential to the efficient operation of many production processes *—and is the most modern pH instrument available.*

▶ With the development of today's increasingly complex chemical processes, the need arose for faster, simpler methods of analytical control. To meet this need Beckman developed the *Quartz Spectrophotometer* . . . an instrument that embodies many unique advancements and saves many hours in making complicated analytical measurements. Covers the full visible, ultraviolet and near infrared.



▶ Major advancements in petroleum refining—aviation gasoline, synthetic rubber, toluene, etc.—have revolutionized refinery practices, making new methods of control essential. Modern refineries, by using the *Beckman Infrared Spectrophotometer*, are now able to save many hours in complex hydro-carbon analyses, making this instrument one of the key factors in operating today's refining processes.

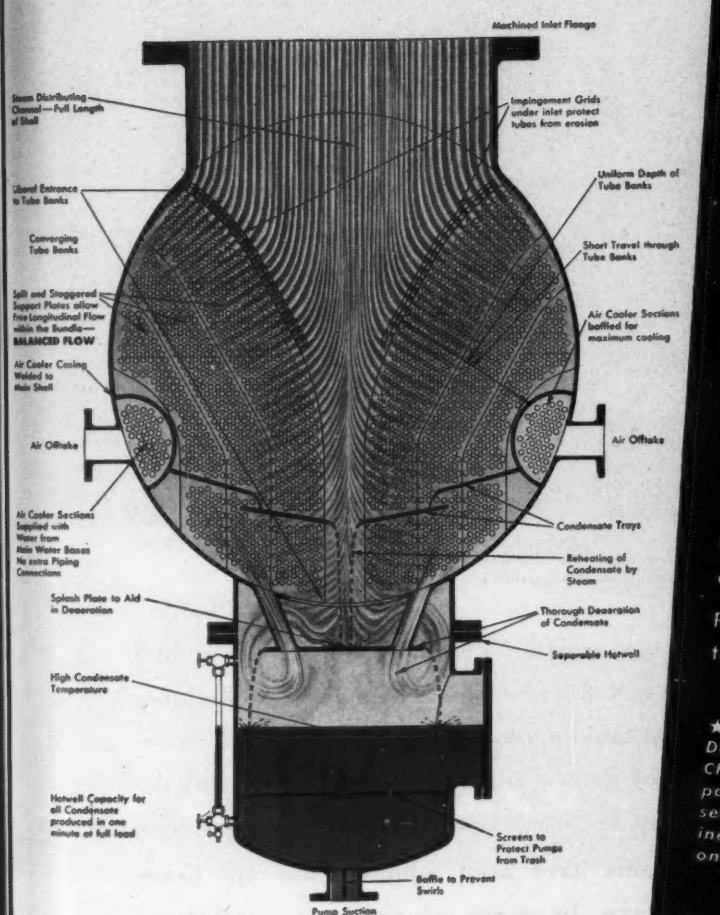
THIS is but a brief outline of the *many* important advancements in instrumentation pioneered and perfected by the Beckman staff. Perhaps Beckman research and ingenuity in developing advanced instruments for controlling modern industrial processes can help in the solution of *your* instrumentation problem.

Why not write our engineering department? *Beckman Instruments, National Technical Laboratories, South Pasadena, California.*

BECKMAN

STRUMENTS CONTROL MODERN INDUSTRIES

THE ROSS TWIN BANK CONDENSER DESIGN *has become a general trend*


Machined Inlet Flange
Steam Distributing Channel—Full Length of Shell
Impingement Grids under inlet protect tubes from erosion
Liberal Entrance to Tube Banks
Uniform Depth of Tube Banks
Converging Tube Banks
Short Travel through Tube Banks
Split and Staggered Support Plates allow Free Longitudinal Flow within the Bundle—BALANCED FLOW
Air Cooler Sections baffled for maximum cooling
Air Cooler Casing Welded to Main Shell
Air Offtake
Air Offtake
Air Cooler Sections Supplied with Water from Main Water Boxes No extra Piping Connections
Condensate Trays
Reheating of Condensate by Steam
Splash Plate to Aid in Deaeration
Thorough Deaeration of Condensate
Separable Hotwell
High Condensate Temperature
Hotwell Capacity for all Condensate produced in one minute at full load
Screens to Protect Pumps from Trash
Baffle to Prevent Swirls
Pump Suction

TYPICAL ROSS TUBE BUNDLE
in Cross Section, showing Steam Distributing Features.

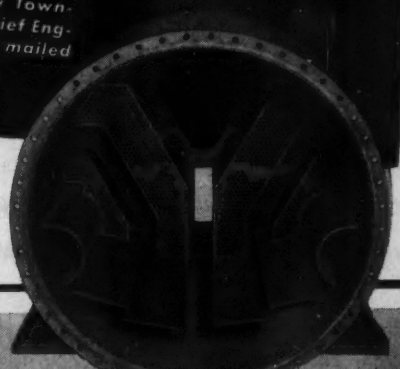
There is a definite trend towards divided tube bank layout in Surface Condensers. More and more condenser manufacturers are using it. Today most of the leaders are producing this design.

But, this divided bank idea is nothing new to Ross. Many years ago, Ross engineers started working on it — doing exhaustive research, building units, making performance tests and numerous trial installations. Soon the layout became standard with Ross.

The first broad disclosure of this type of tube layout was made in a paper* presented by the chief engineer of Ross Heater & Mfg. Co. before the American Society of Mechanical Engineers in 1933.

So Ross points with pride to another "First" in Surface Condenser engineering and fabrication, which holds a position of great importance alongside all-welded steel construction—also a Ross innovation.

★ *"Surface Condenser Design and Operating Characteristics", a 50-page paper by Townsend Tinker, Chief Engineer of Ross, mailed on request.*



INTERNAL ARRANGEMENT
Divided and Offset Tube Support Plates, Condensate Trays and Air Cooler Shells.

ROSS HEATER & MFG. CO., Inc.

Division of AMERICAN Radiator and "Standard" Sanitary Corporation

GENERAL OFFICES AND PLANT • 1419 WEST AVENUE • BUFFALO 13, N. Y.

Fires Like This
Need Not Mean Total Loss

NATIONAL FOAM CONTINUOUS FOAM PRODUCTION SYSTEM

One of the two blacked-out tankers which collided off the Florida Coast, October 20th, setting fire to thousands of gallons of aviation gasoline, pours out dense columns of smoke.

RECENTLY, a tanker after a similar collision burst into flames almost instantly. National Foam and Fire Fighting Equipment on that tanker soon brought the fire under control, smothering the flames with its foam blanket, saving the tanker and most of its precious cargo of aviation gasoline.

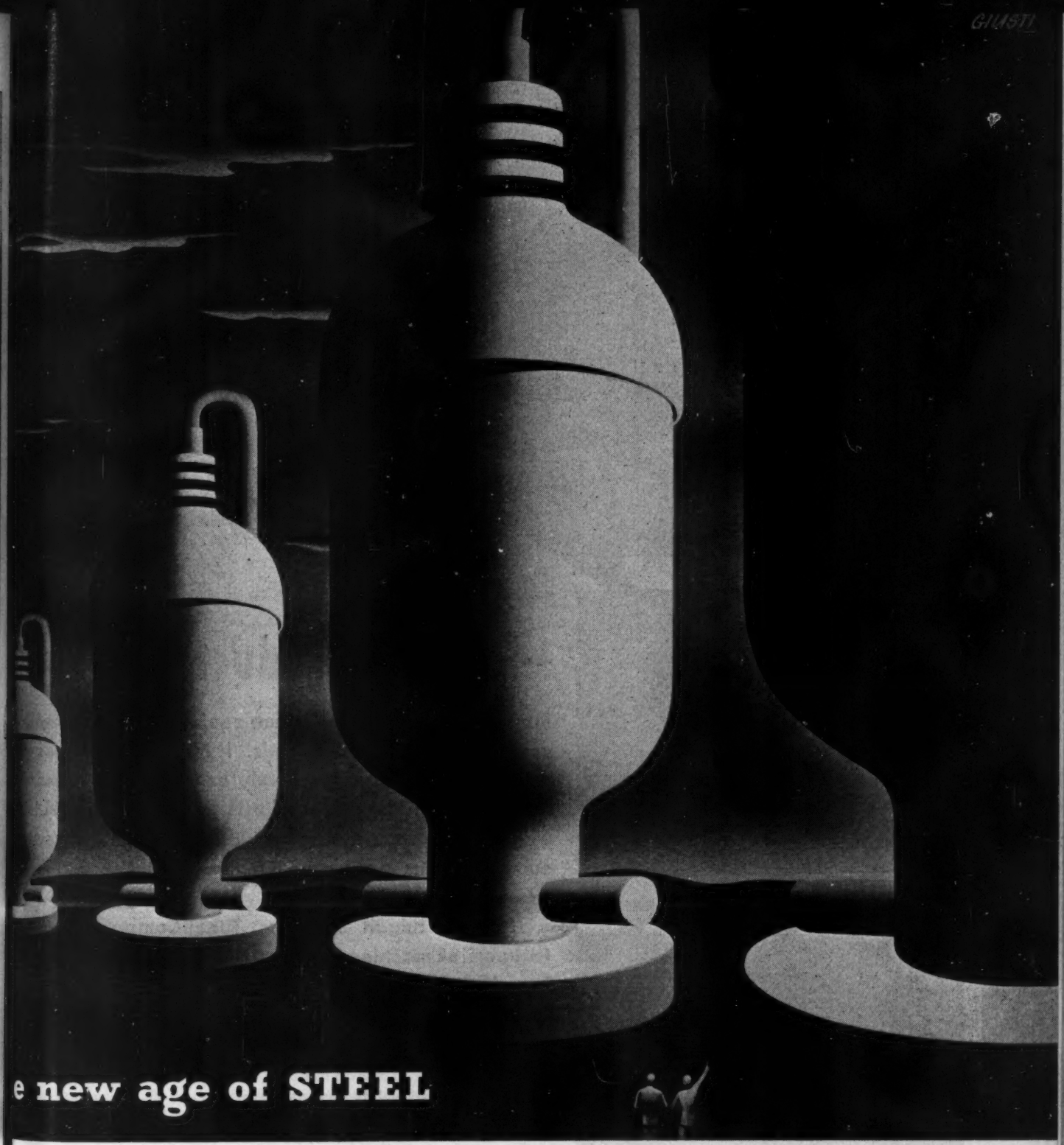
National Fire Foams have been adopted and are being used extensively by the U. S. Navy, by most oil refineries, and large industrial plan.s.

National Foams produce a gas-tight blanket sealing out the oxygen, sealing in the combustible gases, and effectively eliminating flashbacks.

NATIONAL FOAM SYSTEM, INC.

Specializing in Foam Fire Protection

1632 Sansom St., Philadelphia, Pa.



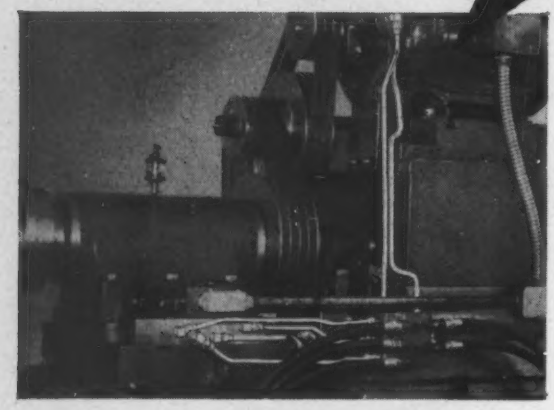
Creative steel-making at Midvale is a partnership of imagination and science. Together they have perfected the most valuable alloys known to the industry. Together they look forward to challenges of the future. Whenever the question arises: "Can this be made of steel successfully?" Midvale welcomes the opportunity to look at the blue prints.

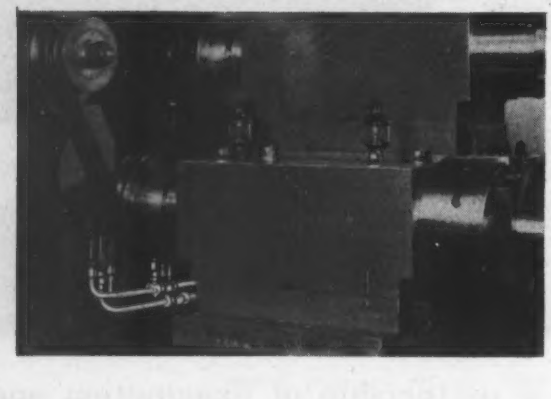
MIDVALE

Custom Steel-Makers to Industry

PHILADELPHIA • New York • Chicago • Pittsburgh • Washington • Cleveland • San Francisco

with four stars





—for the Production Front

Many machine tools today are equipped with hydraulic controls and hydraulic feeds. Hydraulic oil pressure drives their tables as positively as it swings battleship turrets, as precisely as it adjusts laboratory apparatus.

Seamless steel tubing provides the necessary pressure lines for an ever increasing number of these machine tools.

From Michigan Seamless Tube Company, manufacturers of machine tools can obtain recommendations based on long experience in making pressure tubing, both for peacetime needs and for the war effort.

WHAT DO YOU WANT TO KNOW ABOUT TUBING?

In addition to original development work on pressure tubing, the Laboratory of the Michigan Seamless Tube Company is constantly engaged in studies of specific tubing problems. Ask for suggestions. If necessary, the Laboratory will conduct special studies to supply the information you need.

BACK THE ATTACK ★ ★ BUY WAR BONDS

MICHIGAN TUBING

MICHIGAN SEAMLESS TUBE COMPANY

SOUTH LYON • MICHIGAN

ARMY E NAVY

Awarded Feb. 12, 1943

First Star Sept. 9, 1943

Ernie Pyle, *FAMED WAR CORRESPONDENT,* finds pure water vital to our fighting men

ERNIE PYLE, FAMED SCRIPPS-HOWARD WAR CORRESPONDENT

". . . you could almost say an army marches on its water," wrote Ernie Pyle in a recent dispatch from the Mediterranean front. "When a water point is found, the engineers wheel in their portable purifying unit. This consists of a motorized pump, and sand filter, chlorinating machine and a collapsible 3,000-gallon canvas tank. The chlorine we inject comes in powder form in 1 gallon cans—we usually use 1 part of chlorine to a million parts of water. The engineers of the 45th Division brought with them enough chlorine to last 6 months. In addition to chlorine, alum and soda ash are injected into the water."

THAT "chlorine in powder form" which Ernie Pyle speaks of is, of course, high test calcium hypochlorite, and, as likely as not, it's Mathieson HTH. That soda ash, too, is probably fused soda ash in tablet form made by Mathieson especially for use by our armed forces overseas.

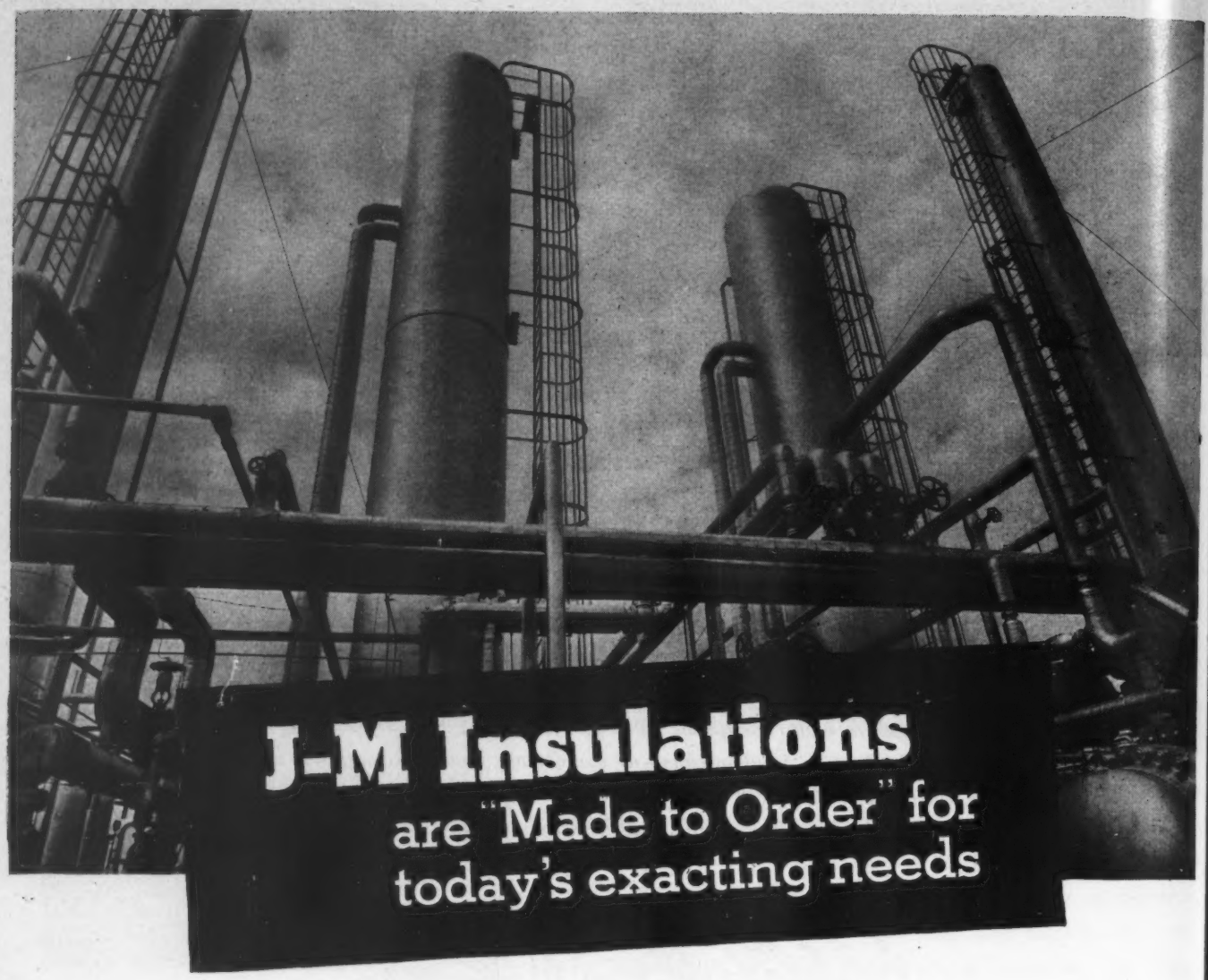
Not as spectacular but just as important a war job is being done on the production front by other Mathieson Chemicals—caustic soda, soda ash, liquid chlorine, ammonia, sodium chlorite, sodium methylate, magnesium metal, liquid and solid carbon dioxide. These products are vital raw materials in nearly every phase of American war production, including ships, planes, tanks, guns, gasoline, clothing, food, medical supplies and many other materials which will go to make up final victory for the United Nations.

Mathieson CHEMICALS

ARMY NAVY

THE MATHIESON ALKALI WORKS (Inc.) 60 EAST 42nd STREET, NEW YORK, N. Y.

LIQUID CHLORINE . . . SODA ASH . . . CAUSTIC SODA . . . BICARBONATE OF SODA . . . BLEACHING POWDER . . . HTH PRODUCTS . . . AMMONIA, ANHYDROUS and AQUA . . . FUSED ALKALI PRODUCTS . . . SYNTHETIC SALT CAKE . . . DRY ICE . . . CARBONIC GAS . . . SODIUM CHLORITE PRODUCTS . . . SODIUM METHYLATE



J-M Insulations
are "Made to Order" for today's exacting needs

J-M Industrial Insulations cover every type of heat and cold control. Each type of insulation is tailor-made to fit the particular job for which it was designed.

In addition: Johns-Manville's 85 years' experience in every conceivable type of insulation problem makes it possible for J-M Engineers to design insulation applications for special conditions such as those encountered in the production of synthetic rubber and high-octane gasoline. Following are just a few of the many types of J-M Industrial Insulations:

For all-round service at temperatures between 600° and 1900° F., J-M Superex Combination Insulation. Inner layer of J-M Superex, outer layer of J-M 85% Magnesia or Asbesto-Sponge Felted provide high heat resistance and efficiency. Blocks and pipe covering.

For steam lines up to 700° F.—J-M Asbesto-Sponge Felted Pipe Insulation provides high salvage value, unusual durability. 3-ft. sections. Thicknesses from 1" to 3". Integral waterproof jacket for outdoor use.

For refrigerated service—J-M Rock Cork. Basically mineral. Can't rot, won't support vermin or mold. In sheets, 18" to 36", 1" to 4" thicknesses. Pipe covering in 3-ft. sections with integral waterproof jacket.

For boiler drums, water walls, tanks, towers, breechings—J-M 85% Magnesia Blocks, highly efficient at temperatures up to 600° F. Sizes 3" x 18", 6" x 36", 12" x 36", flat or curved. Thicknesses 1" to 4".

For furnace insulation up to 1900° F.—J-M Superex Blocks, for years the most widely used block insulation at these temperatures. Sizes, 3" x 18", 6" x 36", 12" x 36". Thicknesses, 1" to 4", flat or curved.

For furnace insulation up to 2600° F.—3 types of J-M Insulating Brick, 4 types of J-M Insulating Fire Brick, are available. Furnished in all standard 9" shapes of the 2½" and 3" series, as well as in specials.

OTHER JOHNS-MANVILLE PRODUCTS FOR THE PETROLEUM INDUSTRY

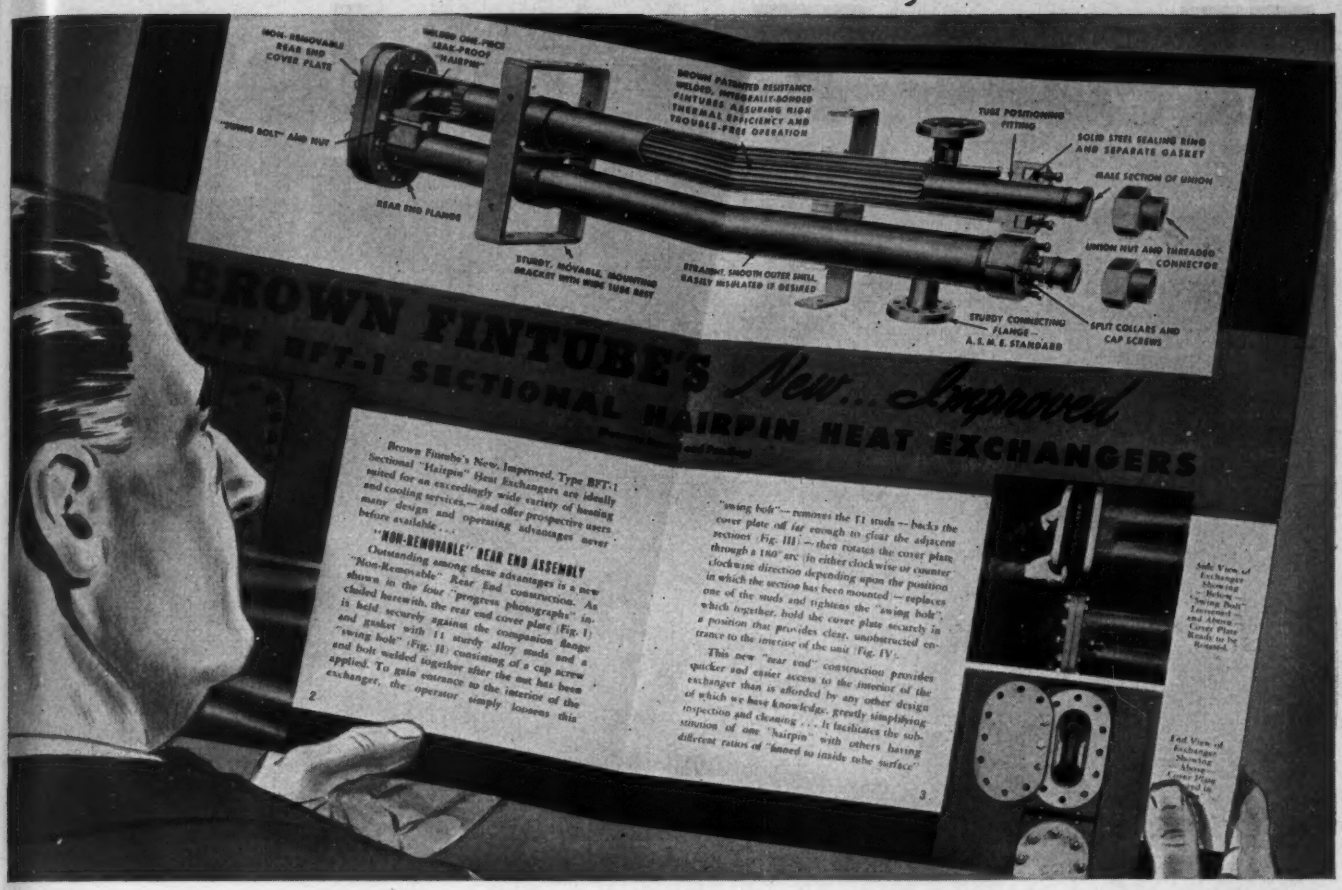
Asbestos Pipe Line Felts • Packings • Flat and Corrugated Transite for Walls and Roofs • Electrical Materials • Industrial Friction Materials • Transite Pressure Pipe Built-Up Roofing • Refractory Products

For details on these materials, and on the complete J-M Insulation line, write for catalog GI-6A. Johns-Manville, 22 East 40th Street, New York 16, N. Y.

JOHNS-MANVILLE JM PRODUCTS

Johns-Manville INDUSTRIAL INSULATIONS

FOR EVERY TEMPERATURE . . . FOR EVERY SERVICE


BROWN FINTUBE'S New... Improved
BFT-1 SECTIONAL HAIRPIN HEAT EXCHANGERS
NON-REMOVABLE REAR END COVER PLATE
WELDED ONE-PIECE LEAK-PROOF "HAIRPIN"
"SWING BOLT" AND NUT
REAR END FLANGE
BROWN PATENTED RESISTANCE-WELDED, INTEGRALLY-BONDED FINTUBES ASSURING HIGH THERMAL EFFICIENCY AND TROUBLE-FREE OPERATION
TUBE POSITIONING FITTING
SOLID STEEL SEALING RING AND SEPARATE GASKET
MALE SECTION OF UNION
UNION NUT AND THREADED CONNECTOR
STURDY, MOVABLE, MOUNTING BRACKET WITH WIDE TUBE REST
STRAIGHT, SMOOTH OUTER SHELL, EASILY INSULATED IF DESIRED
STURDY CONNECTING FLANGE — A. S. M. E. STANDARD
SPLIT COLLARS AND CAP SCREWS
Brown Fintube's New, Improved, Type BFT-1 Sectional "Hairpin" Heat Exchangers are ideally suited for an exceedingly wide variety of heating and cooling services,—and offer prospective users many design and operating advantages never before available . . .
"NON-REMOVABLE" REAR END ASSEMBLY
Outstanding among these advantages is a new "Non-Removable" Rear End construction. As shown in the four "progress photographs" included herewith, the rear end cover plate (Fig. I) is held securely against the companion flange and gasket with 11 sturdy alloy studs and a "swing bolt" (Fig. II) consisting of a cap screw and bolt welded together after the nut has been applied. To gain entrance to the interior of the exchanger, the operator simply loosens this
"swing bolt"—removes the 11 studs—backs the cover plate off far enough to clear the adjacent sections (Fig. III)—then rotates the cover plate through a 180° arc to either clockwise or counter clockwise direction depending upon the position in which the section has been mounted—replaces one of the studs and tightens the "swing bolt", which together, hold the cover plate securely in a position that provides clear, unobstructed entrance to the interior of the unit (Fig. IV).
This new "rear end" construction provides quicker and easier access to the interior of the exchanger than is afforded by any other design of which we have knowledge, greatly simplifying inspection and cleaning . . . It facilitates the substitution of one "hairpin" with others having different ratios of finned to inside tube surface"

FREE ON REQUEST

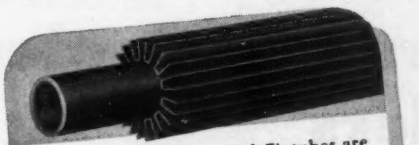
BULLETIN 432 GIVES FULL DETAILS

• Engineers, works managers and operating men in all plants having heating and cooling problems, will want a copy of Bulletin No. 432... It gives full details of the new "sectional" heat exchangers that give users many advantages never before obtainable...

Outstanding among these new features is a "Non-removable" rear end assembly—see views above—that provides quick, easy access to the interior of the exchanger. This construction greatly simplifies inspection and cleaning—facilitates the substitution of one "hairpin" with others to secure optimum operation in different duties—and is of particular advantage when the exchangers are mounted high overhead, since it avoids the use of bell housings or other heavy members, and the work of removing these, lowering them to the ground, raising them back up, and putting them on again, for even the most routine inspection.

The new "head seal" is compact—holds the tube and shell in proper alignment—avoids any outboard stress or strain,—and can be assembled easily with a standard wrench.

Other advantages are welded one-piece "hairpins",—the use of Brown resistance-welded, integrally-bonded Fintubes as the heat transfer medium—and —and— But get the *complete* story, together with dimensions of standard sizes, performance data, etc. It's all in Bulletin 432. Send for a copy today!



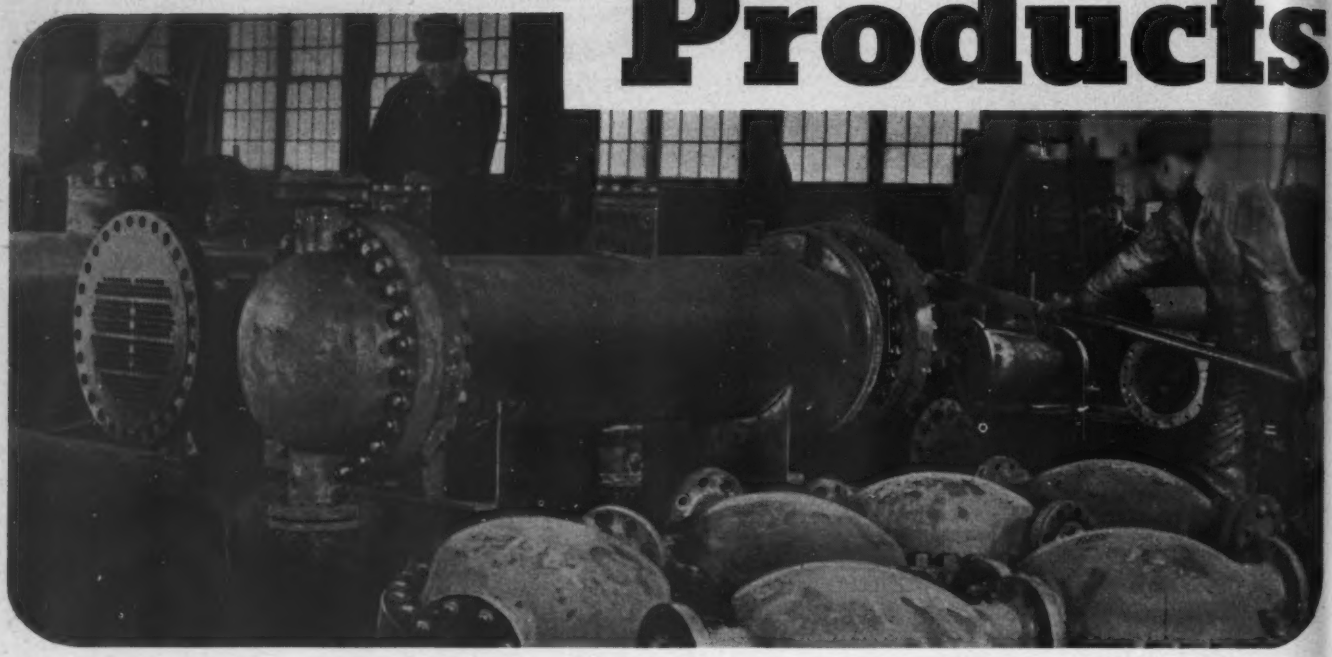
Brown integrally-bonded Fintubes are used in all Brown Fintube Heat Exchangers,—are available in exchangers made by most other manufacturers,—and are ideally suited for many other heating and cooling services. Furnished in plain "longitudinal" or "cut and twisted" types,—wide range of sizes, in low carbon or special steels. Design assistance furnished gladly.

THE BROWN FINTUBE CO.

121 FILBERT STREET • ELYRIA, OHIO

MANUFACTURERS OF INTEGRALLY BONDED FINTUBES AND FINTUBE HEAT EXCHANGERS

Heat Transfer Products



Assembling heat exchange equipment at one of the H-T-P plants for hydrostatic test at 1200 lb. per sq. in. pressure

Fabricators of a complete line of HEAT EXCHANGE, PRESSURE VESSEL AND VACUUM EQUIPMENT

Heat Exchangers
Condensers
Heaters and Coolers
Reboilers
Barometric Condensers
Steam Jet Air Ejectors
Tanks and Towers

Manufacturing Plants at
Carbondale, Pa.
Pottstown, Pa.
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HEAT TRANSFER PRODUCTS, INC.
ENGINEERING and SALES OFFICES — 90 WEST STREET, NEW YORK 6, N. Y.
DESIGNERS, ENGINEERS and MANUFACTURERS of ALL TYPES of HEAT EXCHANGERS

Looking ahead with Asbestos

"Leave it to that starter cartridge to do a job. A snap of the switch and the engine's *gotta* spin. Helps get a plane into the air—*sure*—when a split-second counts! Smart idea, that cartridge—and I understand one of the most important things in it is a small disk made of asbestos packing."

Right you are, Sergeant. That asbestos disk in the back of the cartridge directs the entire explosive action forward. What's more, it's K&M Asbestos Sheet Packing in 75% of all aircraft starter cartridges.

K&M is a name that a lot of airmen will remember when they go back to civilian jobs. They will know it stands for downright dependability. They will rely on it for better packing performance with air, steam, oil, water, acid or gas in the "V" years to come.

Emergency production for war has taught manufacturers many a lesson—and as with K&M, has pointed out the way to produce more, faster, with less. We have confidence that Industry will use this important lesson—aided by constant research—to help in building a better peacetime world

* * *

Nature made asbestos;
Keasbey & Mattison, America's asbestos pioneer,
has made it serve mankind . . . since 1873

KEASBEY & MATTISON
COMPANY, AMBLER, PENNSYLVANIA

Makers of

asbestos-cement shingles and wallboards; asbestos and magnesia insulations for pipes, boilers, furnaces; asbestos textiles; asbestos electrical materials; asbestos paper and millboard; asbestos marine insulations; asbestos acoustical material; asbestos packings; asbestos corrugated sheathing and flat lumbers; asbestos-cement pipe for water mains

You Get

INSTANT ACTION

POSITIVE CONTROL

LOWER UPKEEP

LONGER SERVICE

with HOMESTEAD Quarter-Turn Valves

INSTANT ACTION because a Quarter-Turn *fully opens* or *closes* these valves. They operate 16 to 28 times *faster* than screw-stem types.

POSITIVE FLUID CONTROL because cam presses seating surfaces firmly together in closed position, yet valve operates freely. Sealed bottom, bonnet and stem, prevent wasteful outside leakage.

LOWER UPKEEP AND LONGER SERVICE because seating surfaces are protected in the closed position and turned completely out of the fluid path in the open position. Thus shielded from corrosion or erosion by fluids, longer life is assured.

HOMESTEAD QUARTER-TURN VALVES are made in sizes, types and metals for most of your valve needs; for pressures to 3000 pounds and temperatures to 750 degrees F. Consult our engineering department for special valves designed to your own specifications. Write for copy of Valve Reference Book No. 38.

Maritime's two-flag, highest production award to our men and women making valves for the Victory Fleet.

HOMESTEAD VALVE MFG. CO.

P. O. BOX 16 CORAOPLIS, PENNSYLVANIA

INTERNATIONAL MIXERS

TYPE "N" DIRECT DRIVE

Blend motor fuels with a time saving of from 70% to 95%.

Release tank for charging in much shorter time.

Save a great proportion of power formerly used.

Are invaluable from an agitation standpoint in new aeroplane fuel products.

Increase production without installation of additional tanks.

Can be fitted with any type of tank—spheroids, cone or pontoon roof types

Decrease time of tank car or tanker holdover.

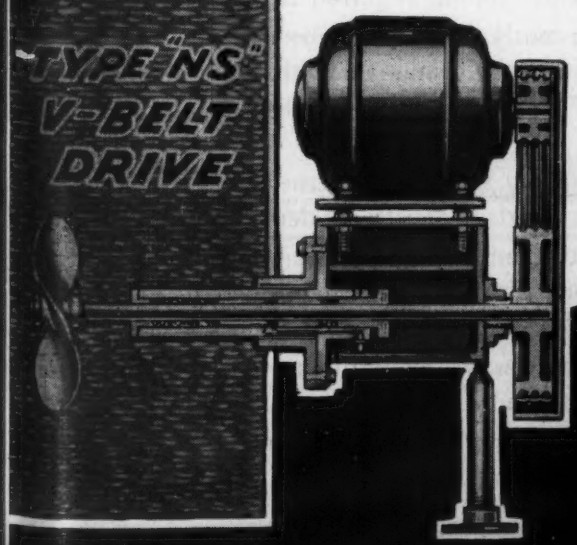
Cut maintenance cost due to heavy duty design.

Cut losses of evaporation to a minimum.

Save much time and expense in caustic washing, liming operations and lubrication oil blending, etc.

Are equipped with the latest design of double lantern bearings.

Your engineers will want our new Technical Mixing Catalog No. 101.

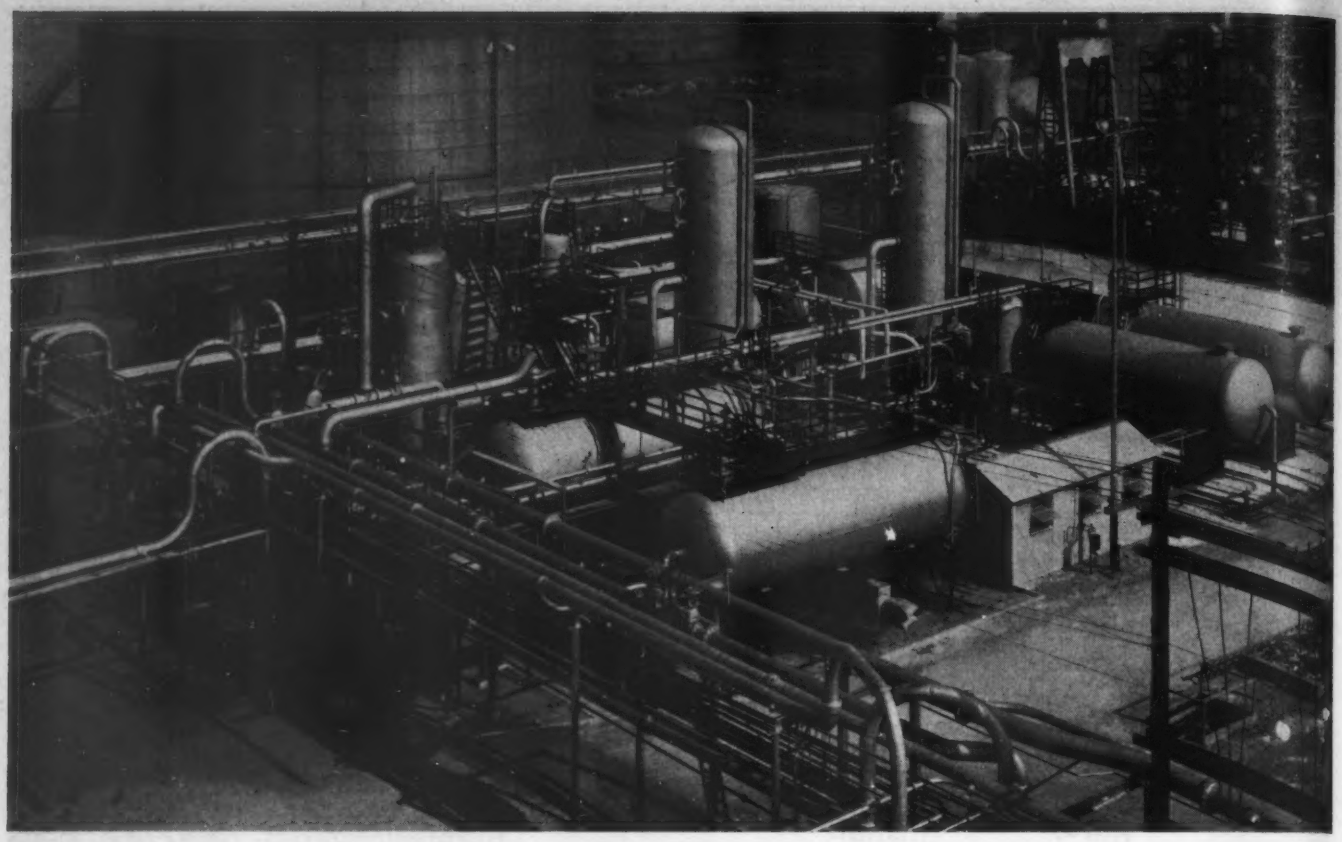


TYPE "NS" V-BELT DRIVE

International products cover the entire field of liquid and solids mixing—Portable Mixers, Top Entering Permanent Mixers, Side Entrance Mixers, Autoclaves, Kettles, Heat Exchangers, Condensers, Emulsifiers, Digesters, Ribbon Type Dry Blenders, Conical Type Dry Blenders—as well as CONTINUOUS MIXING for process plants.

INTERNATIONAL ENGINEERING, INC.

15 PARK ROW, NEW YORK CITY DAYTON, OHIO 407 S. DEARBORN, CHICAGO



CAPACITY

Today the construction of every refinery, synthetic rubber and petro-chemical plant is a race against time. And in this race more and more engineers and builders are looking to Houston Pipe and Steel Company for fabrication and erection of the maze of high pressure and high temperature piping required in these modern plants.

We have been constantly delivering more tonnage for these war-important installations during the emergency than any other like plant in America—and this volume grows progressively from month to month.

The best reason we can give for this growth is that no company has used more vigorous efforts to satisfy the demands of its customers.

With our fabricating and erecting divisions now geared to the greatest capacity in our history we are equipped to take care of present needs and an increasing circle of customers.

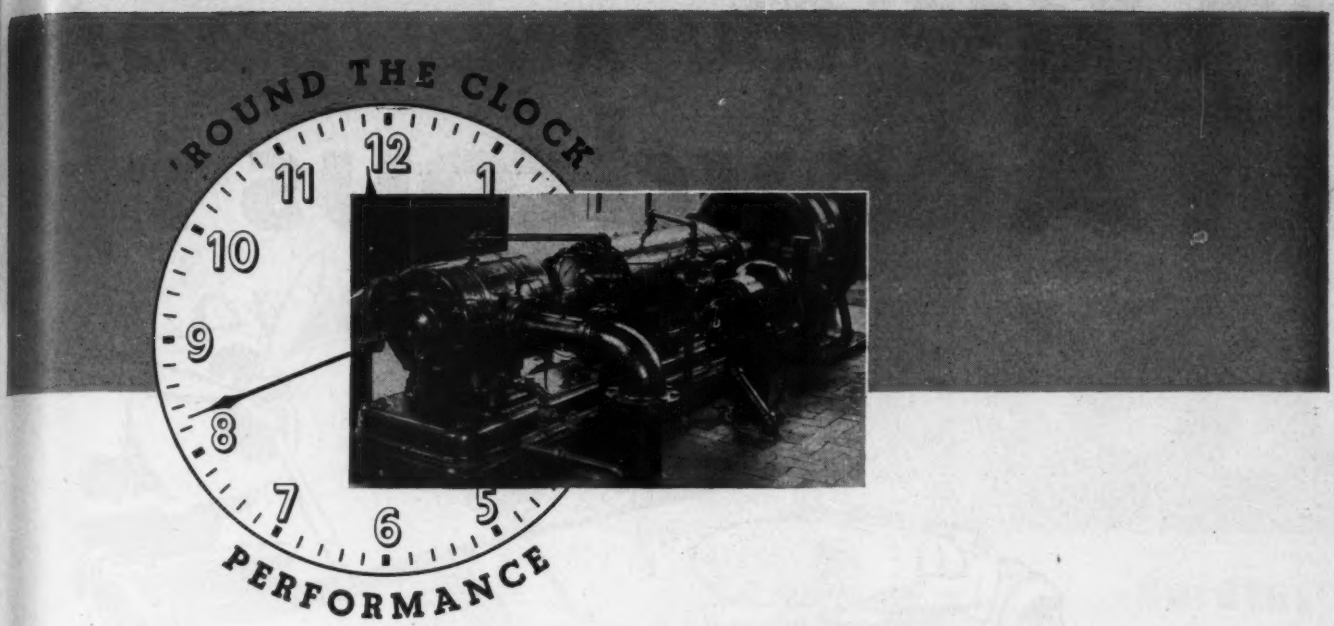
Our engineers are always available to discuss your piping problems without obligation.

COMPLETE PIPING SERVICE

HOUSTON PIPE & STEEL CO.

4300 CALHOUN ROAD • P. O. BOX 2, HOUSTON

PHONE C. 4-2714 • LONG DISTANCE: HOUSTON 424 • TELETYPE: HOUSTON 123



Fuller Rotaries Give it to You

FACTS THAT PROVE THEIR WORTH . . .

A plant engineer in a war industry writes: "It is now approaching the third year of continuous operation for your two-stage compressor, (1800 C.F.M., 100-lb. pressure) during which time we are glad to report that the service load factor has been in the neighborhood of 99.9 per cent."

Another—"Your two-stage compressor, (100 C.F.M., 90-lb. pressure) has run 23 hours per day almost continuously for four years and has given no trouble." Not a cent was spent for repairs during these four years.

In a foundry—During three years' operation only $3.90 was spent for repairs on a two-stage compressor. (330 C.F.M., 100-lb. pressure).

Performance such as this warrants your careful consideration . . . lost time can never be recovered. Install Fullers for day in and day out service. Get acquainted with Fuller Rotaries . . . send in the coupon below.

SEND FOR THIS BULLETIN

FULLER COMPANY
Catasauqua, Pa.

Please send Bulletin C-5, describing Fuller Rotary Compressors and Vacuum Pumps.

Name..... Title.....

Company.....

Address.....

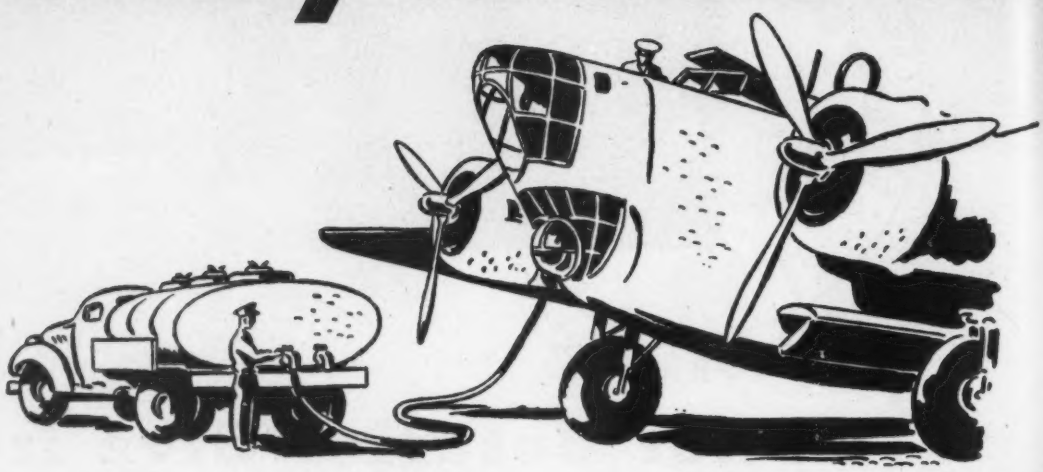
City..... State.....

C-92

FULLER COMPANY-CATASAUQUA, PA.

CHICAGO, 3 Marquette Bldg. | WASHINGTON, 5, D. C. Colorado Bldg. | SAN FRANCISCO, 4 Chancery Bldg.

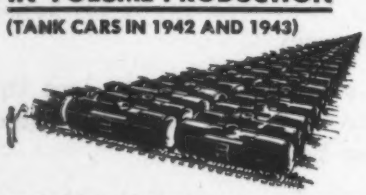
IT TAKES *THOUSANDS* OF TONS of Anhydrous HF



IN PIONEERING
(6-LB. CYLINDERS IN 1938)

IN DEVELOPING
(210-LB. CYLINDERS IN 1939)

IN VOLUME PRODUCTION
(TANK CARS IN 1942 AND 1943)



HARSHAW HAS PLAYED A LEADING PART

As in the case of other products, Harshaw has developed a high degree of purity in our HF to meet the rigid specifications of the petroleum industry. The fact that Harshaw helped develop specifications which have been established as the standard, speaks for itself.

TO SATISFY THE APPETITES OF THESE *HUNGRY* WAR-BIRDS

Vast quantities of Anhydrous Hydrofluoric Acid are needed today for alkylation to make 100-octane aviation gasoline for our war birds.

Behind the tank car of Anhydrous HF which rumbled from our siding about a year ago—the first ever shipped to a petroleum refiner—were months of learning the hard way—by making mistakes and finding ways to avoid them. But those struggles have given Harshaw that invaluable "Plus" called *experience* in making this important catalyst. As a result, Harshaw is today a major producer of Anhydrous HF and, to keep pace with the ravenous demands of war, our facilities for production are being expanded as rapidly as possible.

WRITE FOR YOUR COPY OF THIS FREE HF BOOK

Here between two covers, is helpful data dealing with Anhydrous HF. The 26 pages contain information on chemical and physical properties, materials for plant construction and *even first aid suggestions.* Write for your copy. A post card will do.

HARSHAW

THE HARSHAW CHEMICAL CO.
1945 E. 97th Street, Cleveland, Ohio
BRANCHES IN PRINCIPAL CITIES

SKILLED MEN BEHIND THE PRINTED PAGE

CONVERTIBLE
AIR-OPERATED
Free-Vane
CONTROLLERS
for
TEMPERATURE
FLOW
LIQUID LEVEL
PRESSURE
DRAFT
HUMIDITY
pH VALUE
TIME CYCLE
As you look through Bristol's Bulletins, and then investigate Bristol's application engineering in all aspects of automatic control, you will find yourself moving toward a practical solution of many primary wartime difficulties:
1. Lack of skilled men
2. Shortage of raw materials
3. Need to increase output without increasing space or equipment
4. Unnecessary spoilage and rejects
5. Errors in putting new products into production

Read About BRISTOL'S Polymerization Controller Now At Work In Synthetic Rubber Plants

A single instrument of simple construction now controls polymerization process. Though widely varying operating factors and varying quantities of cooling medium are required, temperature is held rigidly at the correct control point. *Another example of Bristol's extra control refinements in refinery and related processes.* Write for Bulletin 103, describing automatic controls essential for synthetic rubber production.

FREE Bulletins of Particular Interest to Refinery Executives

THE BRISTOL COMPANY
111 Bristol Road, Waterbury 91, Conn.

Please send me Bulletin A 112, and the following, as checked:

☐ Bulletin 103 — describing Automatic Control of Synthetic Rubber Process with Bristol Instruments.

☐ Bulletin 536 — describing Bristol's pH controller with Beckman shielded glass and calomel electrodes. This instrument, useful in a number of refinery processes, has been specified in every synthetic rubber plant contracted for under the government program.

☐ Bulletin F 500 — describing Bristol's Flow Meters — both mechanical and electric types for recording, indicating, integrating and controlling flow of gases, liquids, steam, including alkalies and acids. Information concerning pneumatic transmission also included.

☐ Bulletin P1200 — describing Bristol's Pyromaster Pyrometers. This new bulletin gives detailed information regarding the Pyromaster Potentiometer.

NAME.....

COMPANY.....

ADDRESS.....

.....

Bristol's Bulletins — Clear, Concise, Complete — Sum Up Latest Advances of Wartime Instrument-Engineering

For instance, the Free-Vane system of control, originally developed by the Bristol Company in 1932, is now available in a convertible design, enabling you to adapt your instruments to changing processes by following simple instructions in your own plant. This feature is added to the exceptionally prompt undistorted response of Free-Vane Controllers, arising from the patented, free-floating action of the control mechanism.

Bulletin A 112 describes in 8 concise pages the new convenience and flexibility of Free-Vane Controllers. Write for it, together with other bulletins for your industry, addressing the Bristol Company, 123 Bristol Road, Waterbury, Connecticut.

Bristol's Extra Refinements... Give Better Refinery Control

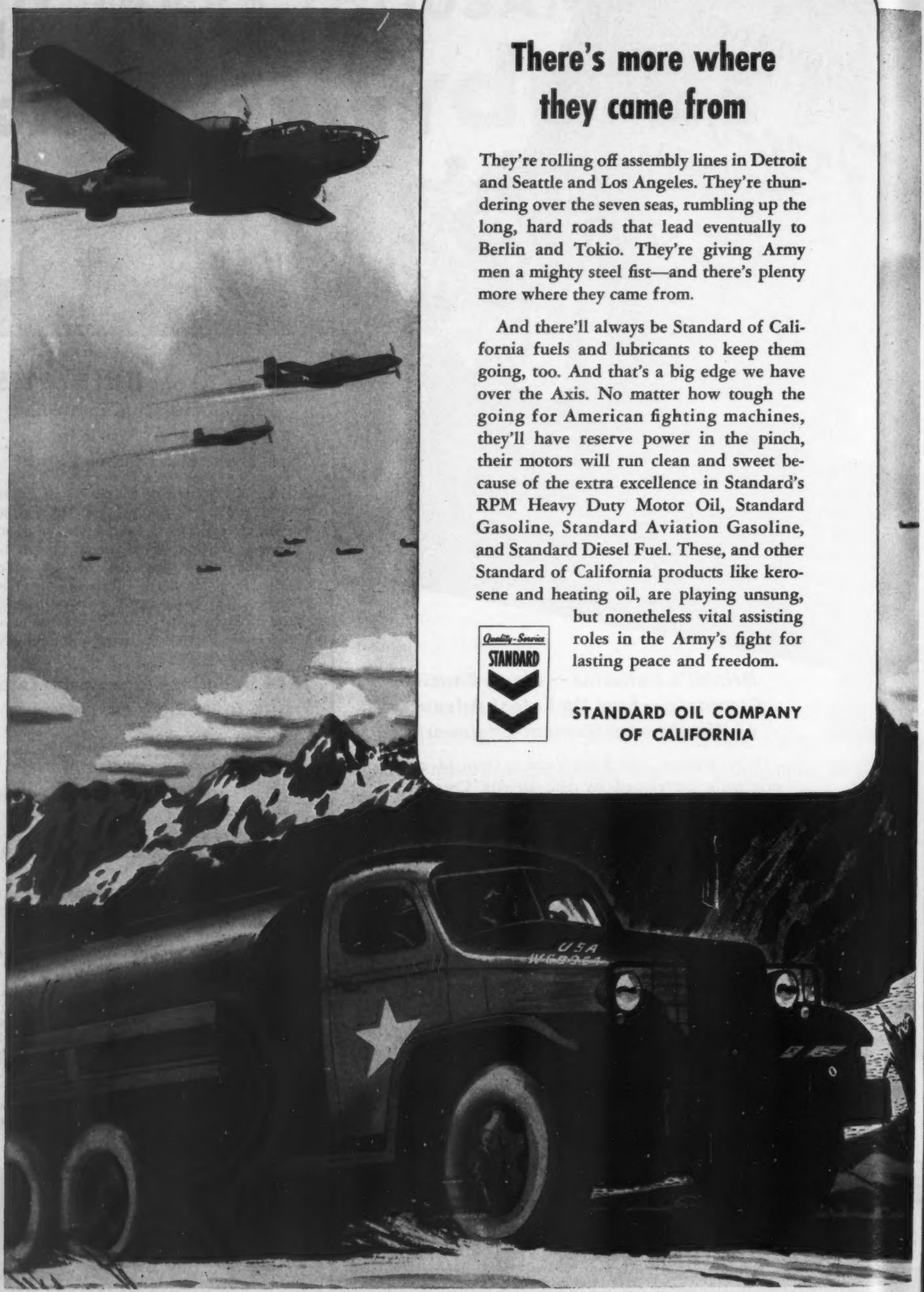
BRISTOL

AUTOMATIC CONTROLLING AND RECORDING INSTRUMENTS

THE BRISTOL COMPANY, Waterbury, Connecticut

The Bristol Co. of Canada, Ltd.
Toronto, Ontario

Bristol's Instrument Co., Ltd.
London, N. W. 10, England



There's more where they came from

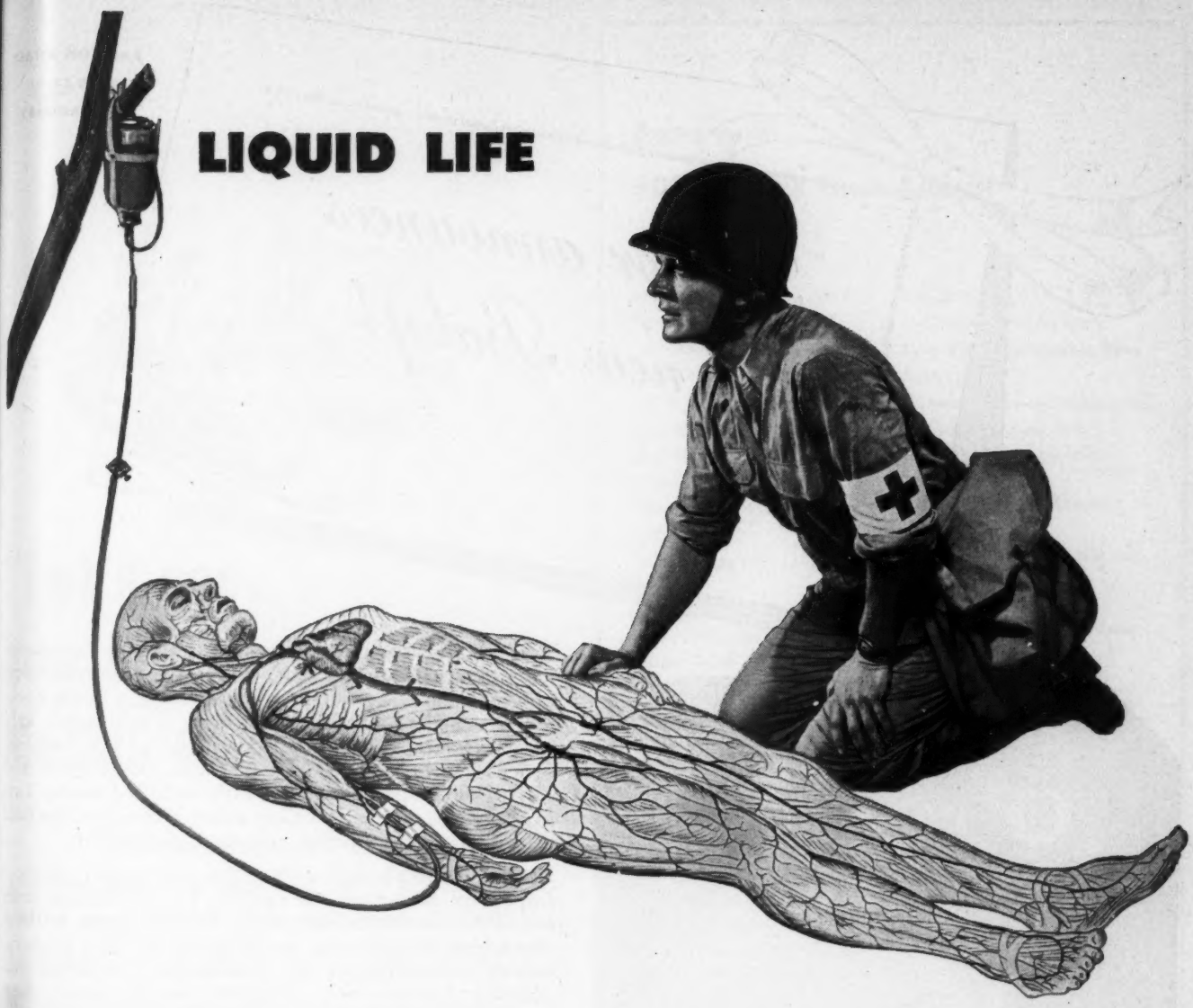
They're rolling off assembly lines in Detroit and Seattle and Los Angeles. They're thundering over the seven seas, rumbling up the long, hard roads that lead eventually to Berlin and Tokio. They're giving Army men a mighty steel fist—and there's plenty more where they came from.

And there'll always be Standard of California fuels and lubricants to keep them going, too. And that's a big edge we have over the Axis. No matter how tough the going for American fighting machines, they'll have reserve power in the pinch, their motors will run clean and sweet because of the extra excellence in Standard's RPM Heavy Duty Motor Oil, Standard Gasoline, Standard Aviation Gasoline, and Standard Diesel Fuel. These, and other Standard of California products like kerosene and heating oil, are playing unsung, but nonetheless vital assisting roles in the Army's fight for lasting peace and freedom.

Quality-Service
STANDARD

STANDARD OIL COMPANY OF CALIFORNIA

LIQUID LIFE



Not bullets, but *surgical shock*, has killed many a soldier in the wars of the past.

Shock is a breakdown of the blood circulatory system. Blood vessels contract. Circulation slows down, almost stops. If shock is too severe, death results.

Today, when a soldier is wounded, blood *plasma* is injected into his circulatory system. The plasma acts as a sort of pump primer . . . fills up the collapsed veins and arteries . . . starts the system working again. By thus counteracting shock, plasma saves lives and reduces suffering.

The whole blood you give at a Red Cross blood donor station goes through much processing before it gets to the front as plasma. At many points throughout the processing accurately-controlled *refrigeration* must be used.

To provide this refrigeration, General Electric has developed dependable refrigerating equipment that is more efficient, more compact and more flexible—to meet difficult war conditions.

This is only one of the many ways General Electric Refrigeration and Air Conditioning are helping to make a better world.

☆ BUY WAR BONDS ☆

General Electric Company, Air Conditioning and Commercial Refrigeration Divisions, Section 4312, Bloomfield, New Jersey.

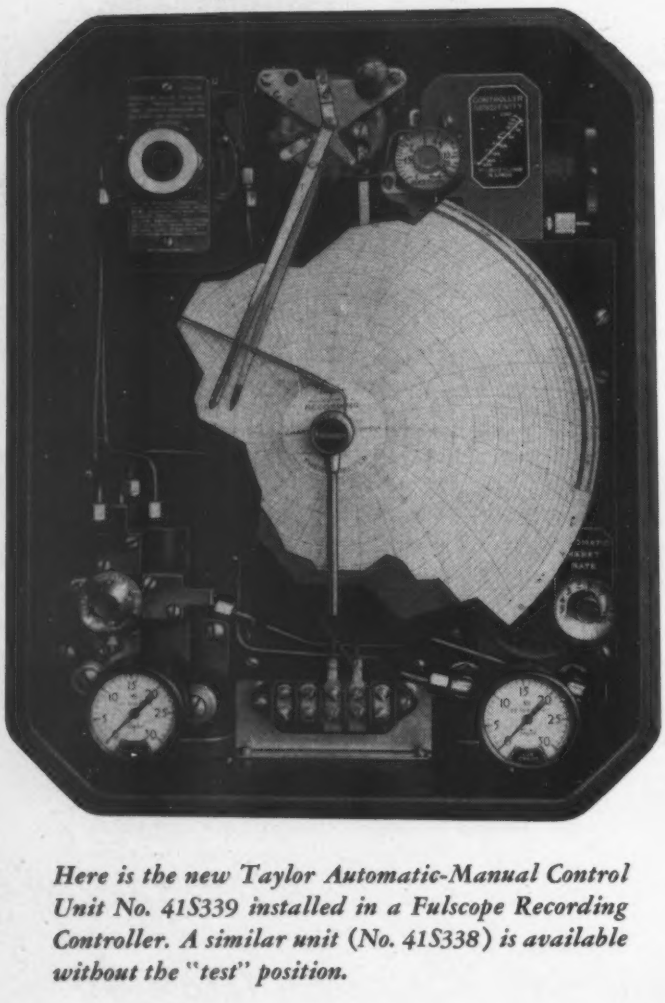
Industrial Refrigeration by

GENERAL ELECTRIC

Hear the General Electric Radio Programs: The "HOUR OF CHARM," Sunday 10 P. M., E W T, N B C . . . "THE WORLD TODAY" News, Every Weekday 6:45 P. M., E W T, C B S

BACK THE ATTACK
WITH EXTRA
WAR BONDS!

Taylor announces a new Baby!



Here is the new Taylor Automatic-Manual Control Unit No. 41S339 installed in a Fulscope Recording Controller. A similar unit (No. 41S338) is available without the "test" position.

WE take considerable pride in this Taylor Automatic-Manual Control Unit, the announcement of which has been delayed while filling a large backlog of urgent, high-priority orders. Thoroughly field tested, in fact it "cut its teeth" on one of the toughest processes in the making of synthetic rubber, this new Taylor development can be easily installed in any Taylor Fulscope single duty Controller already in the field to make it even more versatile than ever before.

Installed completely within the instrument—a most important advantage—it enables you to change from automatic to manual operation or vice versa, without disturbing the process under control. This is particularly advantageous on continuous processes employing fractionating columns, polymerizers, heat exchangers, etc., where a disturbance at one point might be passed on to succeeding operations. It also makes possible any required readjustments or repairs of instrument under operating conditions.

In addition to the three usual positions, Automatic, Manual, and Service, it has a fourth step, the "Test" position—an exclusive Taylor feature. This feature allows instrument to be adjusted and synchronized under operating conditions while process is still being controlled manually, permitting instrument to be "cut in" without up-setting process control. Ask your Taylor Field Engineer! Taylor Instrument Companies, Rochester, N. Y., and Toronto, Canada.

ARMY E NAVY

Taylor Instruments
MEAN
ACCURACY FIRST
IN HOME AND INDUSTRY

Instruments for indicating, recording, and controlling temperature, pressure, humidity, flow, and liquid level.

"Let's see... how do these metals compare?"

Selecting the metal with the right combination of properties for a particular job is easier with the new Inco Bulletin ..."Properties of Some Metals and Alloys"

No. This booklet won't solve any complex technical problems. It isn't intended for that.

But it *does* provide a handy, quick comparison of 108 metals and alloys, compiled in easy-to-read chart form from recent information supplied by the metal producers.

Approximate composition, tensile strength, yield strength, elongation, Brinell hardness, density, specific gravity, melting point, specific heat, thermal expansion coefficient, thermal conductivity, electrical resistivity, and tensile and torsional moduli of elasticity are all listed.

You'll find it a convenience and a time-saver. Use the coupon below, or a postcard, for a complimentary copy or copies.

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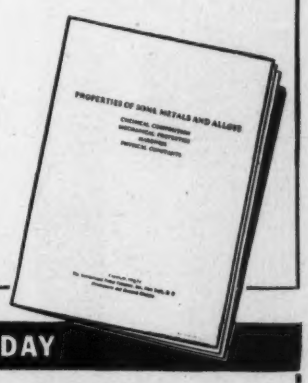
MONEL • "K" MONEL • "S" MONEL • "R" MONEL • "KR" MONEL • INCONEL • "Z" NICKEL • NICKEL

Sheet...Strip...Rod...Tubing...Wire...Castings

Data on 108 Metals and Alloys

Monel (wrought and cast)
"R" Monel, "K" Monel
"H" Monel, "S" Monel
Nickel (pure, wrought and cast)
"D" Nickel, "Z" Nickel
Inconel (wrought and cast)
Hastelloy A, B, C, D
Illium G, R
Alcoa 2S, 3S, 17S, 52S, 53S
Alclad 24S
Alcoa 13, 43, 195, 214, 220
Copper
Red Brass (wrought and cast)
Yellow Brass (high brass)
Naval Brass (Tobin bronze)
Admiralty Brass
Muntz Metal
Manganese Bronze
Silicon Bronze
Phosphor Bronze 5%
Aluminum Bronze
Beryllium Copper
Nickel Bronze (cast)
Nickel Silver 20% (cast)
Nickel Silver 18% (wrought), 13% (cast), 10% (wrought)
Ambrac 20%
Cupro-Nickel 70-30, 55-45
Tin
Chemical Lead
Antimonial Lead
Tellurium Lead
Soft Solder 50-50, 60-40
Zinc
Zilloy 15, 40
Dow Metal E, H, R, K
Silver (pure)
R-T Silver Brazing Alloy
Easy-Flo Silver Brazing Alloy
Gold (pure)
Platinum (pure and commercial)
Iridium-Platinum 10%
Rhodium-Platinum 10%
Palladium (commercial and hard)
Tantalum
Iron (wrought, ingot and cast)
Ni-Tensyliron
Ni-Resist (standard and copper-free)
Ni-Hard, low carbon, high carbon
Carbon Steel (SAE 1020)
Cast Carbon Steel
Cast Alloy Steel
Stainless Steel 304, 309, 310, 316, 321, 347, 325, 410, 420, 430, 446, 312, 330
Cast 18 Cr 8 Ni Steel
Cast 18 Cr 8 Ni 3 Mo. Steel
Invar
Cast 28 Cr 10 Ni Alloy
Cast 35 Ni 15 Cr Alloy
60 Ni 15 Cr Alloy (wrought and cast)
80 Ni 20 Cr Alloy
Iron Silicon Alloy
Durichlor
Durimet



MAIL THIS COUPON TODAY

THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street, New York 5, N. Y.

Please send me_____copies of "Properties of Some Metals and Alloys."

*Name & Title*_____

*Company*_____

P.R. 12-43

*Address*_____

*City*_____ *P. O. Zone*_____ *State*_____

Can You Answer These Questions ON VALVE SELECTION?

TODAY, when it is more important than ever before to keep pipe lines flowing at maximum efficiency, too much care cannot be given to selecting the right valve for each job. Before you "draft" a valve for that all-important line, make sure it is the one you really need.

Here are answers to two frequently asked questions on valve selection, taken from the files of The Kennedy Valve Manufacturing Co. Other problems will be considered in succeeding advertisements in this series.

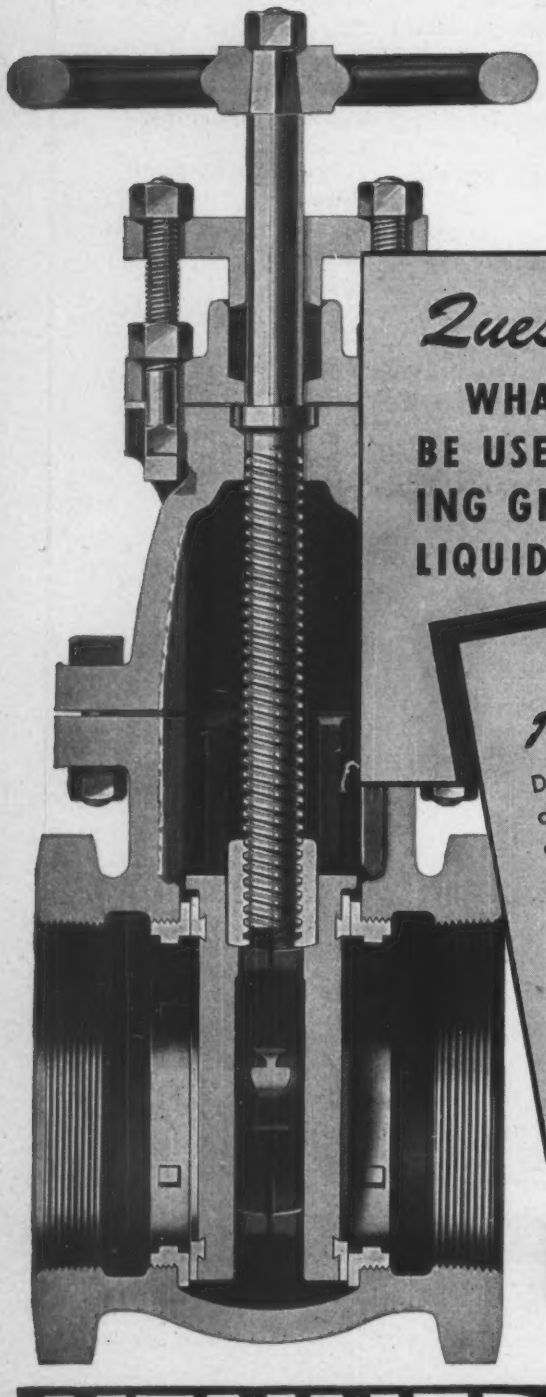


Fig. 2

Questions:

WHAT KIND OF VALVE SHOULD BE USED FOR LIQUIDS CONTAINING GRIT? FOR GUMMY LIQUIDS?

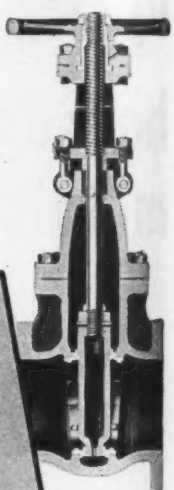


Fig. 1

Answers:

Double-disc gate valves (Fig. 2) are preferable where liquids containing grit are to be handled, because the flexibility of their operating mechanism enables one disc to seat tightly if grit is caught on the other seat, and also because the discs and seats are more readily refaced than those of wedge gate valves. Wedge gate valves (Fig. 1) are used where gummy liquids are handled, and are preferred for steam service by some engineers and operators.

USE DOUBLE-DISC GATE VALVES FOR LIQUIDS CONTAINING GRIT . . . WEDGE GATE VALVES FOR GUMMY LIQUIDS.

If you have a valve selection problem, write to us. As Kennedy makes a complete line of standard gate, globe, angle and check valves, you can be sure of receiving unbiased help. For full description of Kennedy valves, pipe fittings and fire hydrants, send for 240-page Kennedy Catalog.

KENNEDY

VALVES • PIPE FITTINGS • FIRE HYDRANTS

THE KENNEDY VALVE MFG. CO. • ELMIRA, N.Y.

How are you at magic?

WHAT we have to say here is of concern to practical, hard-working oil men who are constantly facing operating problems and don't expect any magic to solve them.

To you we want to emphasize that the way to solve many of these problems is by the use of Hycar synthetic rubber. And here's why:

Hycar can be tailor-made for the job. Oil-swell can be positively controlled, insuring dimensional stability of parts. Hycar has an operating range of —65° to 250° F. It resists abrasion 50% better than natural rubber. Its compression-set characteristics are outstanding.

These are the qualities that engineers have sought for years for oil and fuel hose, motor mounts, vibration dampeners, gaskets, seals, packing and scores of other resilient parts. They are qualities that will result in better, more care-free performance and lower maintenance cost in your operation. Many operating men are already proving it. *Hycar Chemical Company, Akron 8, Ohio.*

Hycar

LARGEST PRIVATE PRODUCER OF BUTADIENE TYPE

Synthetic Rubber

Because of Hycar's outstanding performance in war uses, the demand far exceeds the supply. However, limited quantities are available to your supplier of rubber products, for experimental work. Now is the time to test and prove the value of Hycar in the products you use, so that you can take full advantage of this oil-resistant, resilient material when it is again fully available. Our technical staff and laboratory are ready to work with you.

The Texas Company's policy of many years' standing is to make its patents and inventions available to the petroleum industry at prices that are reasonable.

•

Address:

TEXACO DEVELOPMENT CORPORATION

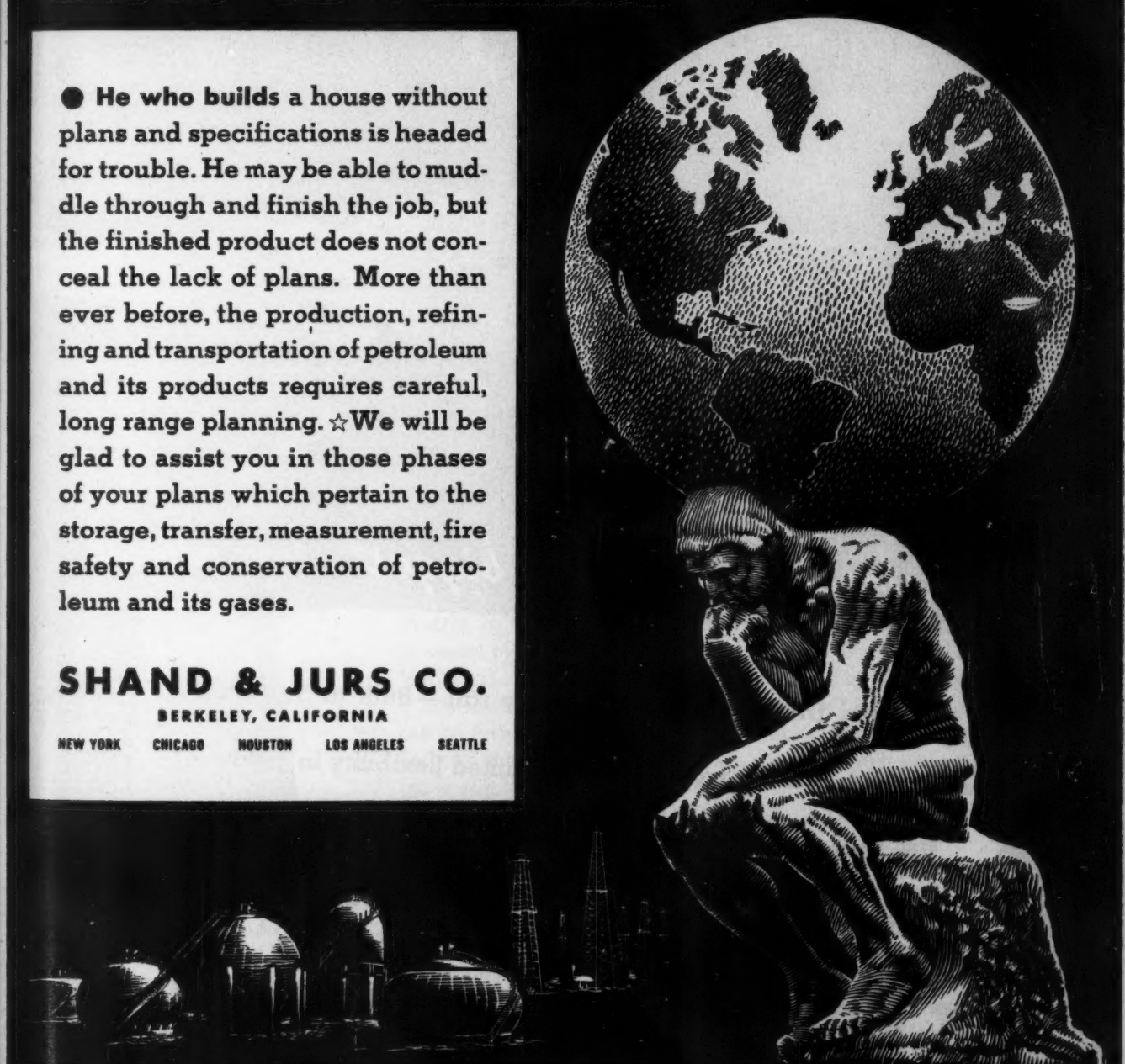
A subsidiary of The Texas Company

26 Journal Square · Jersey City, N. J.

The Future
RESTS ON PLANNING

● **He who builds a house without plans and specifications is headed for trouble. He may be able to muddle through and finish the job, but the finished product does not conceal the lack of plans. More than ever before, the production, refining and transportation of petroleum and its products requires careful, long range planning. ☆We will be glad to assist you in those phases of your plans which pertain to the storage, transfer, measurement, fire safety and conservation of petroleum and its gases.**

SHAND & JURS CO.
BERKELEY, CALIFORNIA
NEW YORK CHICAGO HOUSTON LOS ANGELES SEATTLE



SHAND & JURS

and petroleum takes its biggest step ahead

Refinery Units too large to ship by rail—Built at Sun Ship and shipped by water. Sun's unlimited flexibility in production and shipping facilities offers every Refiner a service that is well worth considering when ordering new equipment.

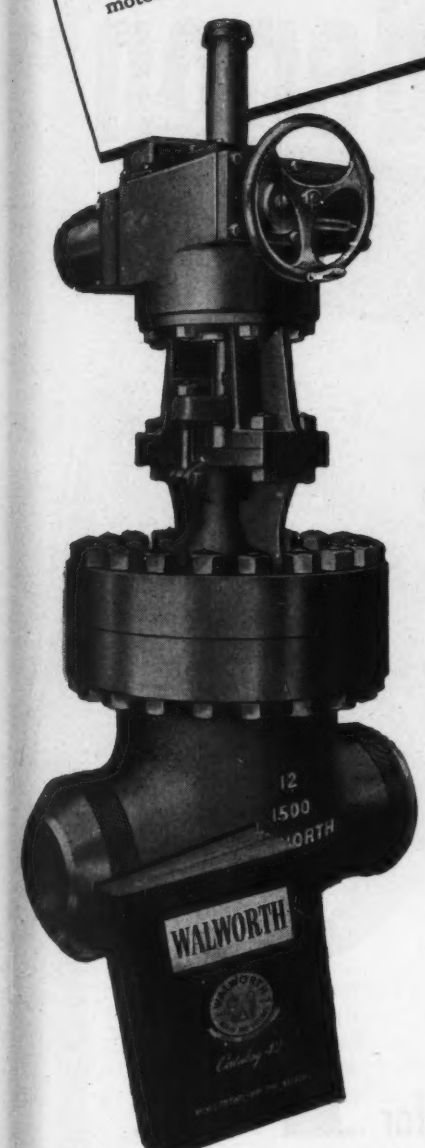
SUN SHIPBUILDING & DRY DOCK CO.
CHESTER, PENNSYLVANIA

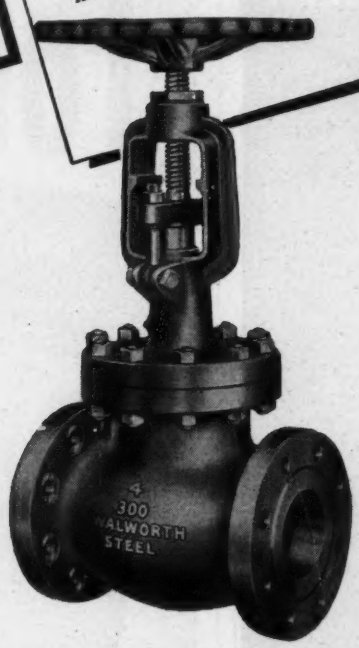
FIT THE VALVE TO THE SERVICE

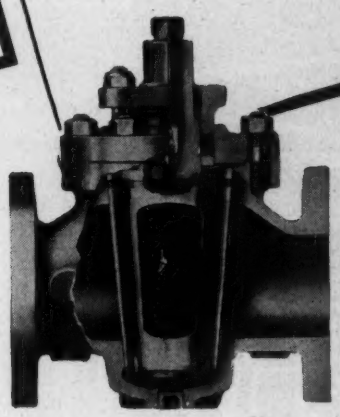
WALWORTH STEEL GATE VALVES can be furnished with welding ends, screwed ends, or flanged ends. Sizes from 2" to 24" inclusive. For hand operation, air or gas motor operation, or electric motor operation.

WALWORTH STEEL GLOBE VALVES can be furnished with welding ends, screwed ends, or flanged ends. Sizes from 2" to 8" inclusive. For hand operation, air or gas motor operation, or electric motor operation.

WALWORTH LUBRICATED PLUG VALVES are made in sizes from ½" to 24" inclusive, for pressures from vacuum to 5000 psi.







YOU CAN CHOOSE A WALWORTH *Steel* VALVE

engineered to your particular service

Be sure that every valve fits the service for which it is selected — and fits exactly. In the Walworth line there's a type for every job, engineered so as to assure maximum economy and worry-free performance. Each Walworth Valve has all the characteristics required for its special service.

For instance, Walworth makes a complete line of cast steel valves. They can be furnished in both gate and globe types with welding ends, screwed ends, or flanged ends. Heavy walls give enduring strength. Deep stuffing boxes eliminate troublesome leakage. Streamlined ports decrease pressure drop. These Walworth Valves have what it takes in every detail of design, metallurgy, and construction to lick your toughest jobs.

For the "difficult" fluids the answer is often found in a Walworth Lubricated Plug Valve. It opens or closes with but one-quarter turn of the valve handle, and a positive tight shut-off is assured. It's easy to operate and remains completely sealed against leakage in both the open and closed positions.

For economy's sake, be sure to "fit the valve to the service."

To help you "fit the valve to the service" you'll find pertinent information on Walworth's complete line of valves, fittings, pipe, and pipe wrenches in the new Walworth Catalog 42. Included are 78 pages of practical engineering data that simplify valve selection and make piping layouts easier. Write, on business stationery, for your free copy. Address: Walworth Company, 60 East 42nd Street, New York, N. Y. Department D9.

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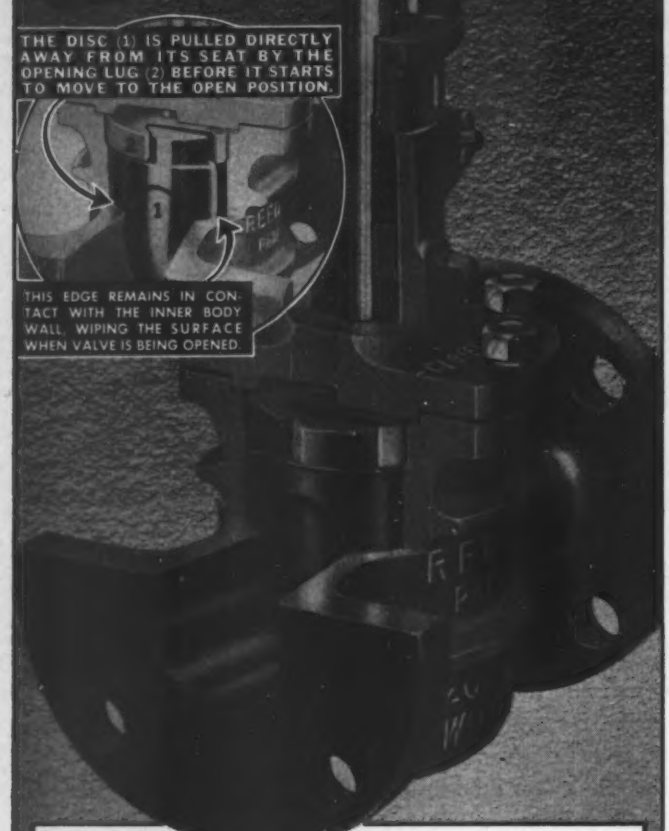
KEWANEE WORKS

WALWORTH
valves AND fittings

WALWORTH ★ VALVES AND FITTINGS ★ ESTABLISHED 1842

REED VALVES *for* EVERY PROCESS-INDUSTRY REQUIREMENT


THE DISC (1) IS PULLED DIRECTLY AWAY FROM ITS SEAT BY THE OPENING LUG (2) BEFORE IT STARTS TO MOVE TO THE OPEN POSITION.
THIS EDGE REMAINS IN CONTACT WITH THE INNER BODY WALL, WIPING THE SURFACE WHEN VALVE IS BEING OPENED.

Reed Valves are designed and constructed to provide positive shut-off and ease of operation under the most severe service conditions with the greatest factor of safety. Materials used are of the highest grade obtainable and rigid inspection and testing schedules assure complete dependability under all conditions of service, pressure and temperatures.

Reed Valves will withstand fatigue strains and overloads — resist shock at low temperatures and retain their easy opening and positive closure characteristics through varying temperatures.

For that extra dependability where the service is toughest Reed Valves have given noteworthy service, especially on hazardous chemical lines where positive closure and the ability to hold pressure is of paramount importance.

SEND FOR REED VALVE CATALOG 41, NOW!

REED VALVE DIVISION
of the REED ROLLER BIT COMPANY
P. O. BOX 2119 HOUSTON, TEXAS

NEW Folder on

Write for Illustrated Bulletin PE-1 on your letterhead . . .

INDUSTRIAL DIVISION
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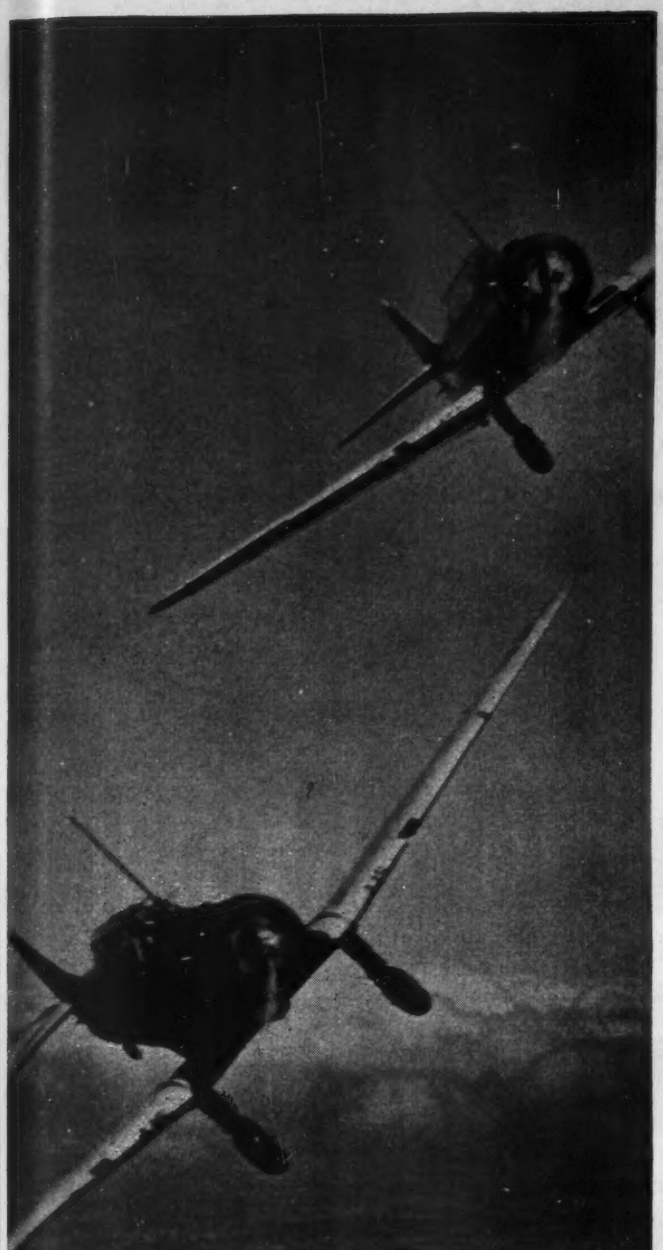
223-H Central Avenue · Johnstown, Penna.



U.S. Army Air Corps

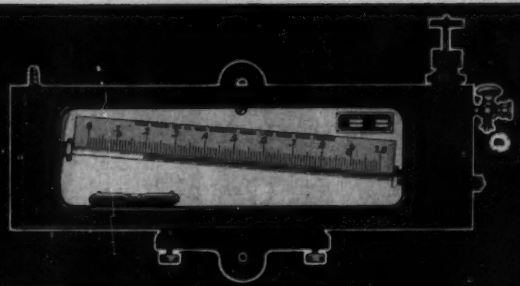
TODAY

Garlock is helping America's war industries and essential civilian industries maintain top-speed production by supplying them with Garlock products that give long, dependable service.

AFTER THE WAR

Garlock will continue to manufacture quality packings, gaskets and oil seals—for America's peace-time industries. The Garlock Packing Company, Palmyra, New York.

Garlock



MERIAM

DRAFT GAUGE
MEASURES LOW PRESSURES AND DRAFTS

Quickly and Accurately

THIS gauge has wide application where low pressures, drafts and differentials are to be measured—such as furnace drafts, pressure drop across filters, and velocity pressures.

It is a *direct reading* instrument with an inclined tube giving increased scale length to permit accurate readings of fractional inches of water pressure.

Housing is of dull black crackle with bracket for wall mounting. Each gauge is individually calibrated, insuring extremely accurate operation.

Each gauge is furnished with standard accessories, ready for operation. Write for Bulletin 4.

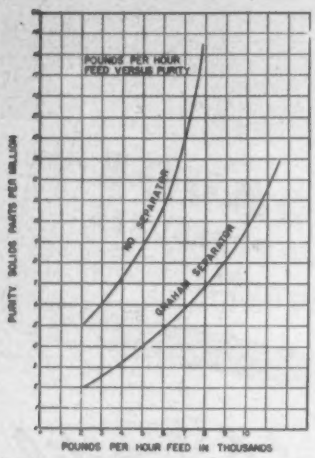
THE MERIAM COMPANY
1971 West 112th St. Cleveland, O.

MERIAM
SINCE 1911

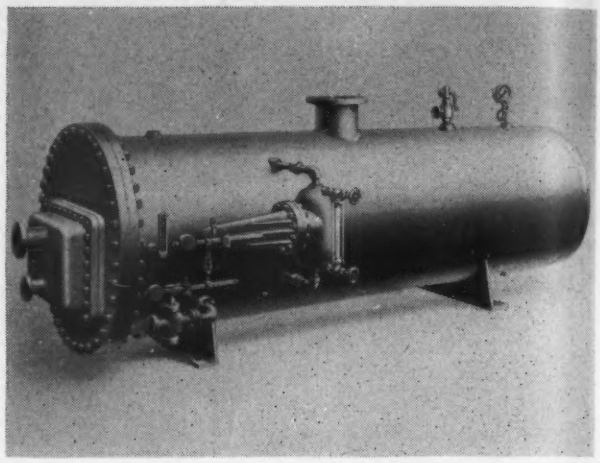
MANOMETERS, METERS AND GAUGES FOR THE ACCURATE MEASUREMENT OF PRESSURES, VACUUMS AND FLOWS OF LIQUIDS AND GASES

EVAPORATORS

SURFACE CONDENSERS • AIR EJECTORS • FEED WATER HEATERS • LUBE OIL COOLERS • EXCHANGERS


POUNDS PER HOUR FEED VERSUS PURITY
NO SEPARATOR
GRAHAM SEPARATOR
PURITY SOLIDS PARTS PER MILLION
POUNDS PER HOUR FEED IN THOUSANDS

ALL GRAHAM PRODUCTS ARE BACKED WITH HIGHLY SPECIALIZED ABILITY . . . OVER A QUARTER OF A CENTURY OF ENGINEERING EXPERIENCE IN DESIGNING HEAT TRANSFER EQUIPMENT



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- **PAGE BELTING CO.** Leather Belting
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- **BETHLEHEM STEEL CO.** Galvanized Sheets, Nails and Wire Rope
- **REPUBLIC STEEL CORP.** Bar Iron, Angles, Shapes
- **HENRY G. THOMPSON & SONS CO.** Milford Hand, Power, Band Saw Blades
- **VULCAN RIVET & BOLT CO.** Bolts and Nuts
- **GREENE, TWEED & CO.** Palmetto Packing
- **J. H. WILLIAMS & CO.** Wrenches, Tongs, Pipe Vises
- **MORSE TWIST DRILL & MACHINE CO.** Reamers, Drills, Taps, Cutters
- **RIDGE TOOL CO.** Wrenches, Pipe Cutters, Vises
- **CRESCENT TOOL CO.** Wrenches, Pliers, Screw Drivers, Punches, Chisels
- **CLOVER MANUFACTURING CO.** Abrasive Materials
- **TOLEDO PIPE THREADING MACHINE CO.** Pipe Dies, and Threading Machines
- **THE DUFF-NORTON MFG. CO.** Jacks

complete line of industrial equipment

PACIFIC takes it!

FROM SUB-ZERO

TO 850 DEGREES

and that's punishment

Type HV—Double Suction, Single-Stage Centrifugal Pump.

Type ITB—Hot oil, Multi-Stage, Horizontal, Forged Steel Shell, Double Case, High Pressure Centrifugal Pump.

THINK OF IT! Centrifugal pumps with discs whirling at 3500 revolutions per minute within a third of a hair's breadth of scraping the housing. That's *precision!* Then pour oil or other liquids of 850 degrees against those discs without expanding and jamming the works. Sounds impossible, doesn't it?

Yet, PACIFIC Engineers did it! They introduced chrome alloy steel in radically new designs and worked out a revolutionary cooling system. Result—pumps that perform with precision, not only at 850 degrees, but also at sub-zero and all the intervening degrees. With long life and economy, too!

That's the kind of punishment Pacific Engineered Pumps are built to take. The tougher the job, the better! And there's a type and size of pump to meet all variables in pumping conditions—oil field, refinery, process, utility, synthetic rubber plants—or what have you?

PACIFIC has the ability and the backing to carry through!

PACIFIC PUMP WORKS

Executive Offices and Plant: Huntington Park, California • *Export Office:* 30 Rockefeller Plaza, New York • *Sales and Service:* Offices in principal cities in the United States • *Affiliated Companies:* Dresser Manufacturing Co., Bradford, Pa.; Clark Bros. Co., Inc., Olean, N. Y.; The Bryant Heater Co., Cleveland, O.; Van der Horst Corp. of America, Cleveland, O., Olean, N. Y.; Bovaird & Seyfang Mfg. Co., Bradford, Pa.; Dresser Manufacturing Co., Ltd., Toronto, Ont., Canada.

PACIFIC *Engineered* PUMPS

ON THE SEVEN SEAS . . .

Wherever our fighting ships and freighters go, K & M equipment goes along...to help bring them back again, *faster.* It's a story of dependability... stamina... extreme sensitivity...the successful development of our more than 65 years of specialization in pressure and fluid control equipment. Send for Catalog #66.

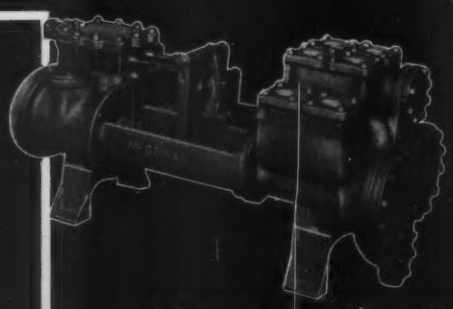
SPECIAL REPAIR DEPARTMENT. *If you can't get new K & M valves and controls, send us your old equipment for repair. By George, we'll do it* fast . . . *10 days to 2 weeks, maximum!*

KM KIELEY MUELLER ESTABLISHED 1879

KIELEY & MUELLER, INC.

PRESSURE & FLUID CONTROL SPECIALTIES

NORTH BERGEN, NEW JERSEY



McGOWAN ENGINEERING

a dependable service

McGowan Pumps are constructed for dependability and economy of operation. Our Engineers are constantly designing McGowan Centrifugal and Reciprocating Pumps to meet rapidly changing present day requirements. All castings are carefully checked by expert metallurgists. While we have attempted to design McGowan Pumps with the best features suiting the large majority of users, our engineering staff is always ready and willing to aid in solving your problems relative to installation and specific requirements.

McGOWAN PUMPS

LEYMAN MANUFACTURING CORP.

The JOHN H. McGOWAN Co. DIVISION

59 CENTRAL AVE., CINCINNATI, OHIO

BRANCH OFFICES

Boston — Norfolk
New York — New Orleans
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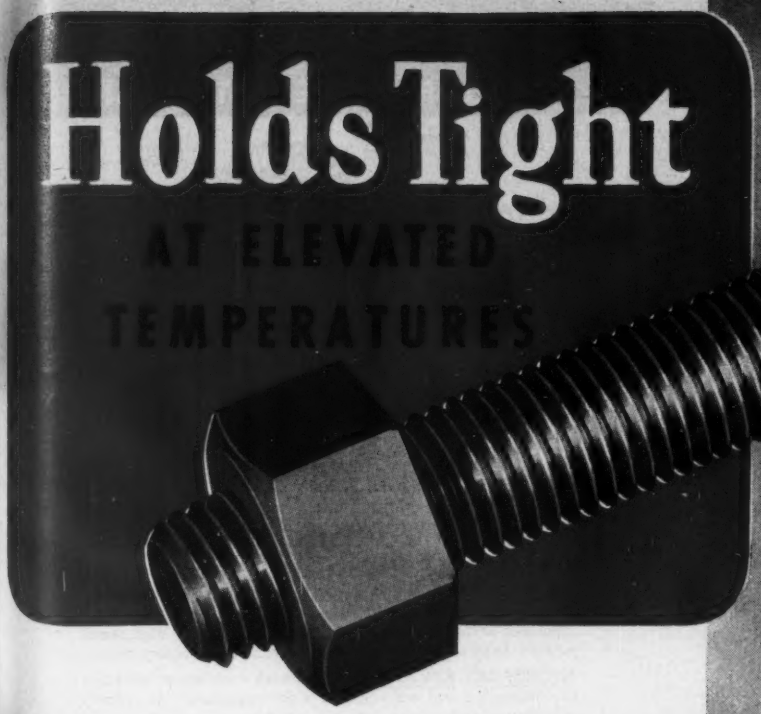
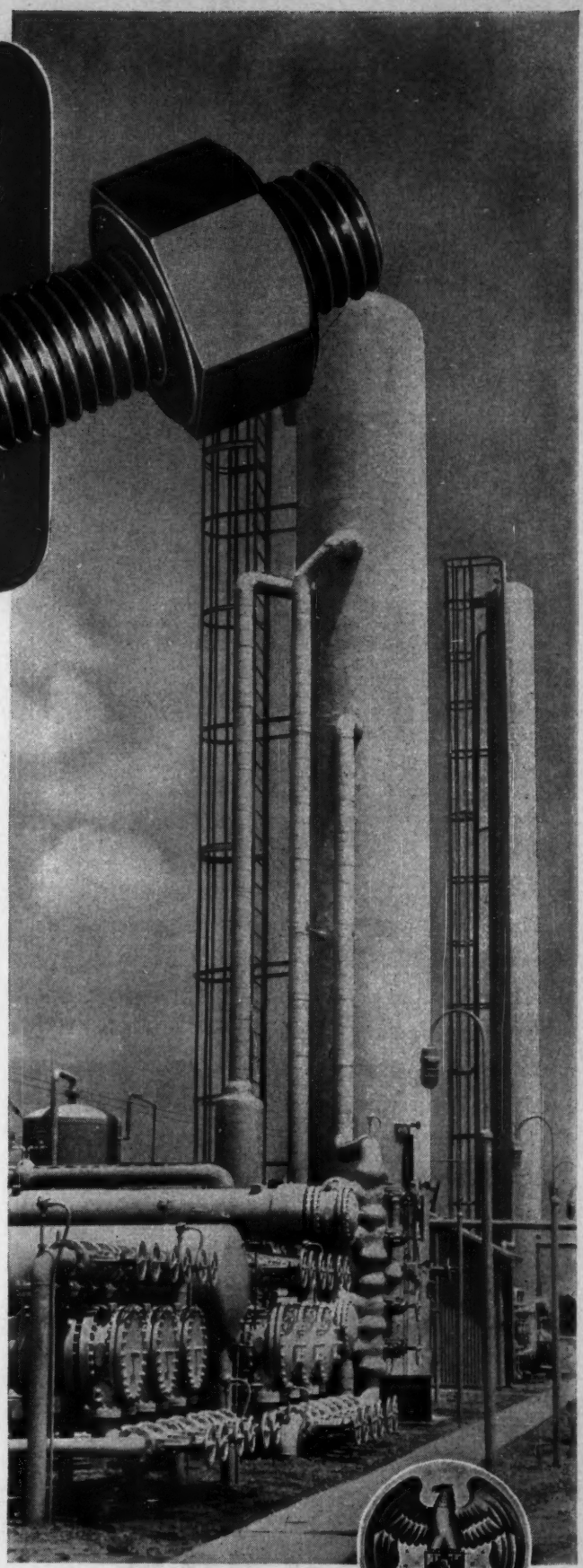
For Complete Engineering Data — Write To:
McGOWAN PUMP DIV.,
LEYMAN MFG. CORP.,
Central Ave., Cincinnati 2,
Ohio, U. S. A.

Holds Tight

AT ELEVATED TEMPERATURES





War action goes on in spite of sweltering equatorial heat. And there must be no letup in the flow of vital war fuels simply because stud bolts let down under the high temperatures of refining processes.

So, take extra precaution when selecting studs for a critical point in production. Guard against failures by installing Republic Upson Alloy Stud Bolts.

They're made tough from the start and are specially conditioned for the most punishing jobs. It's a "cinch" for them to get a clinch on a joint and hold it against tremendous pressures, elevated temperatures and accelerated corrosion. They'll stand up longer to hard wrenching, too.

Don't let studs cause "off stream" time when it's so easy to prevent. Replace with Republic Upson Alloy Studs. Use them for new installations.

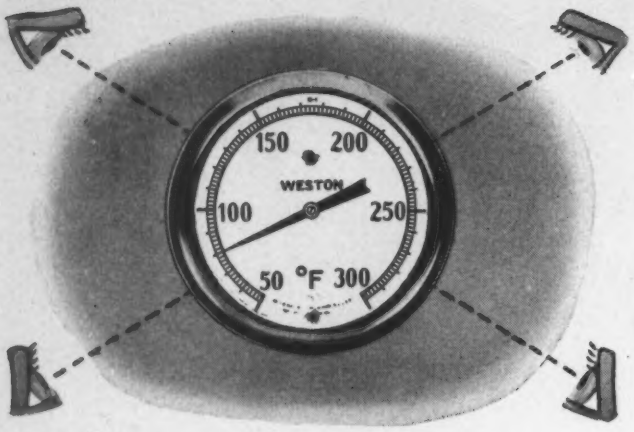
REPUBLIC STEEL CORPORATION
Bolt and Nut Division
Sales Offices · Cleveland, Ohio
GENERAL OFFICES • • CLEVELAND, OHIO
Berger Manufacturing Division • Culvert Division
Niles Steel Products Division • Steel and Tubes Division
Union Drawn Steel Division • Truscon Steel Company
Export Department: Chrysler Building, New York, New York

REPUBLIC

Upson Quality BOLTS AND NUTS

Other Republic products include Electric Weld Casing, Tubing and Line Pipe — Electrunite Heat Exchanger Tubes

THE "EYES" HAVE IT...



Readability is only one advantage of the *All-Metal* TEMPERATURE GAUGE

The WESTON gauge-type thermometer is *far more readable.* But the big point is that *seein's believin'* whenever you read a WESTON. Because its high initial accuracy (1% over the entire scale) is maintained over long periods of time. The reason is... even the temperature element in the WESTON is all-metal! There is no gas, no liquids, no fragile parts. Thus it can withstand vibration or other mechanical abuse without damage or without affecting its accuracy. It's easier to install, too, and no corrections are necessary for capillary or elevation.

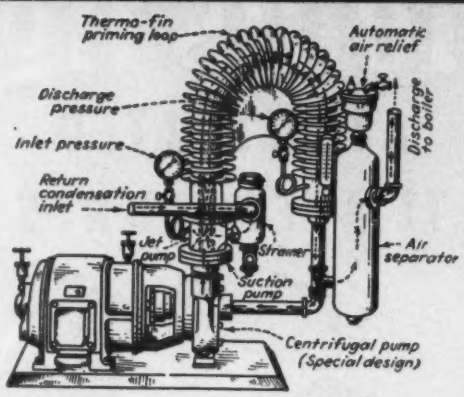
Booklet describing these rugged and dependable thermometers, including types, stem lengths, prices, etc., gladly sent on request. Weston Electrical Instrument Corporation, 655 Frelinghuysen Avenue, Newark 5, N. J.

WESTON

ALL-METAL TEMPERATURE GAUGES

C-B *High-Pressure* CONDENSATE RETURN SYSTEM

for REBOILER CONDENSATE DRAINAGE



EXCLUSIVE JET PUMP DESIGN

OPERATES IN A CLOSED CIRCUIT

MAINTAINS PRESSURE DIFFERENTIAL across process equipment, with discharge of condensate against higher pressures without FLASH LOSS or necessity for high static suction head—flash tank—float control or auxiliary pump

INCREASES EFFICIENCY—assures constant evacuation of condensate and entrained air from equipment—maintains maximum, uniform heat transfer rates

LOWERS STEAM COSTS—by direct return of hot condensate to waste heat boiler—surge tank or pressure return line to boiler plant.

AUTOMATIC IN OPERATION

SUBMIT PROBLEMS without obligation—Ask for Publ #3025

COCHRANE CORPORATION

3115 N. 17th STREET PHILADELPHIA, PA.

TO THOSE WE HAVE SERVED

in the past—we welcome a continuation of this pleasant business dealing.

TO THOSE WE HAVEN'T SERVED

we welcome the opportunity to show what we can do.

DISTRIBUTORS FOR:

TAYLOR Seamless Steel Welding Fittings, Seamless Steel Nozzles, Forged Steel Flanges • GLOBE Seamless Steel Boiler, Condenser and Still Tubes • YOUNGSTOWN Seamless Steel Butt-weld and Lap-weld pipe • FORGED STEEL Unions • JENKINS Valves • LAMSON & SESSIONS Bolts, Nuts and Rivets • WORTH Steel Plates and Heads for Mill Shipments Only • CROSS Perforated Plates and Sheets.

The CORBETT-WALLACE CORPORATION

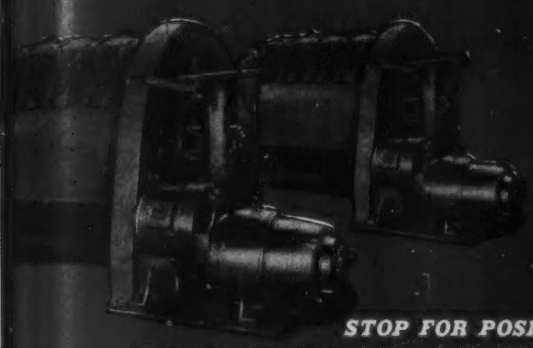
Quality Products Plus Engineering Assistance

SAWYER AND WINTER STREETS

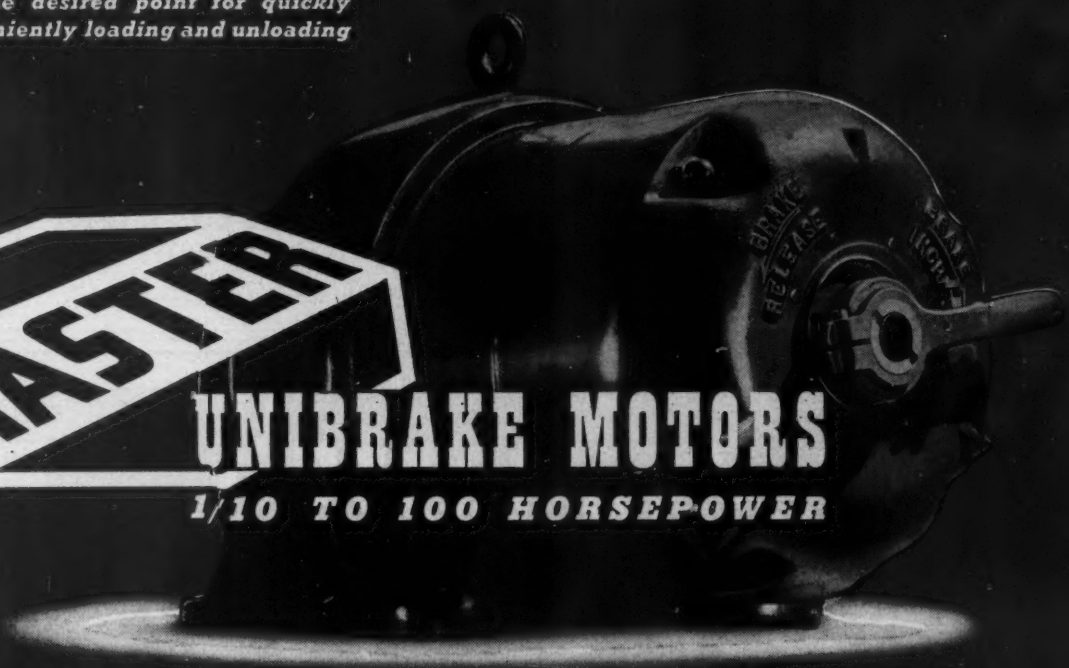
HOUSTON

BUY UNITED STATES WAR BONDS AND STAMPS

SIMPLE COMPACT DESIGN
The electric brake is built into the motor end cover to form a compact, economical, easy to use unit.



STOP FOR POSITION
Stop at the desired point for quickly and conveniently loading and unloading



MASTER UNIBRAKE MOTORS

1/10 TO 100 HORSEPOWER

THE MASTER ELECTRIC COMPANY • DAYTON 1, OHIO

STOP AND HOLD ANY LOAD
Unibrake motors are very advantageous on hoists, elevators, inclined conveyors, etc....

SPEED UP PRODUCTION
Eliminate unnecessary loss of time waiting for equipment to coast to a stop.

THE MOST ECONOMICAL METHOD of removing mercaptan and non-mercaptan sulfur from naphtha to yield gasolines of high lead susceptibility without the use of chemicals is by GRAY CATALYTIC DESULFURIZATION. Refiners are successfully desulfurizing thousands of barrels per day of sulfur-bearing naphthas by the GRAY CATALYTIC DESULFURIZATION PROCESS.

THE GRAY PROCESSES CORPORATION
26 JOURNAL SQUARE · JERSEY CITY, N. J.

A "Pipe" to Install . . .

ACADIA SARAN* Pipe and Fittings

Acadia *Saran*—the thermoplastic pipe that is finding numerous applications in the petroleum industry. Saran is an ideal alternate for critical metal piping. It has high tensile strength—great resistance to pressure, heat and most acids and alkalies—is easily installed. Let Acadia engineers help you in determining where you can use *Saran*. Get the whole story—write for the *Saran* Pipe Booklet.

Acadia Synthetic Products Division
WESTERN FELT WORKS
Chicago 23, Ill.: 4035-4117 Ogden Ave.
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WELD IT . . . .

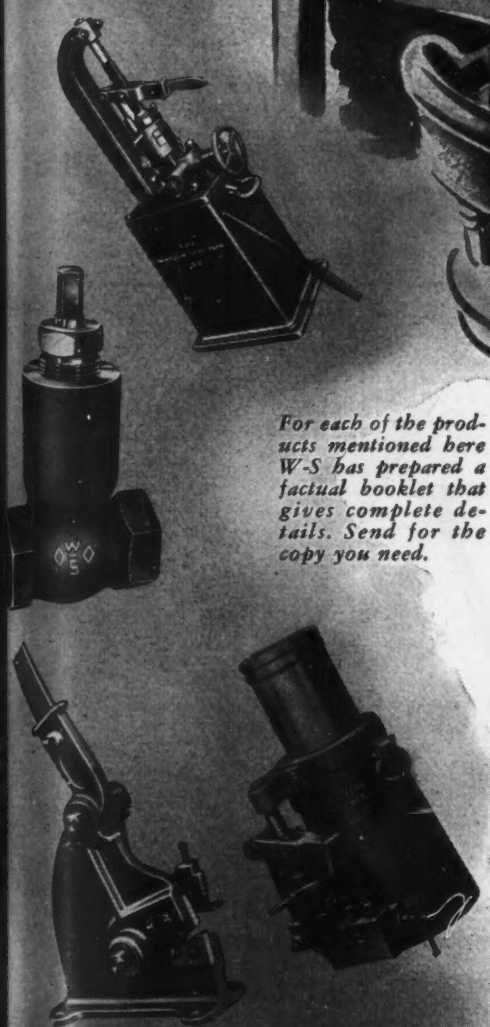
OR THREAD IT!

ACADIA Synthetic PRODUCTS

Processors of Synthetic Rubber and Plastics • Sheets • Extrusions • Molded Parts

*Licensee of the Dow Chemical Company

ECONOMY IN LOW MAINTENANCE COST

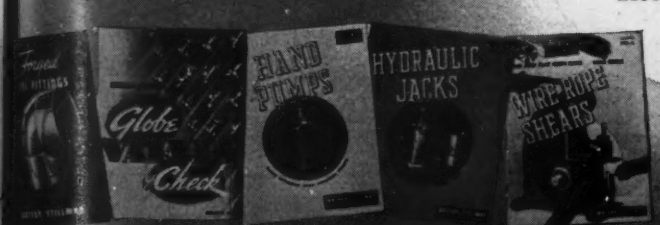


For each of the products mentioned here W-S has prepared a factual booklet that gives complete details. Send for the copy you need.

Many engineers specify Watson-Stillman Forged Steel Fittings and Valves because they KNOW that the best is the lowest in cost in the long run. W-S products are known for their Reliability, Long Wearing Qualities and Efficiency in high or low pressure services. These factors contribute to low maintenance cost, which should be your first consideration when buying fittings and valves.

Maintaining production lines at the present high rate of output requires more than unlimited supply of raw materials and skilled labor. Plant equipment must be kept moving. A breakdown in a pipe line, caused by a leak or structural weakness in a key spot, shuts down the whole system, piles up costs in lost man hours and increased overhead. Such losses might have been avoided by the installation, in the beginning, of W-S Forged Steel Fittings and Valves for high or low pressure service.

Watson-Stillman also manufactures Pumps, Jacks and Wire Rope Shears — both hand and hydraulically operated — in a complete range of sizes and capacities for general shop use. The Watson-Stillman Company, Roselle, N. J.



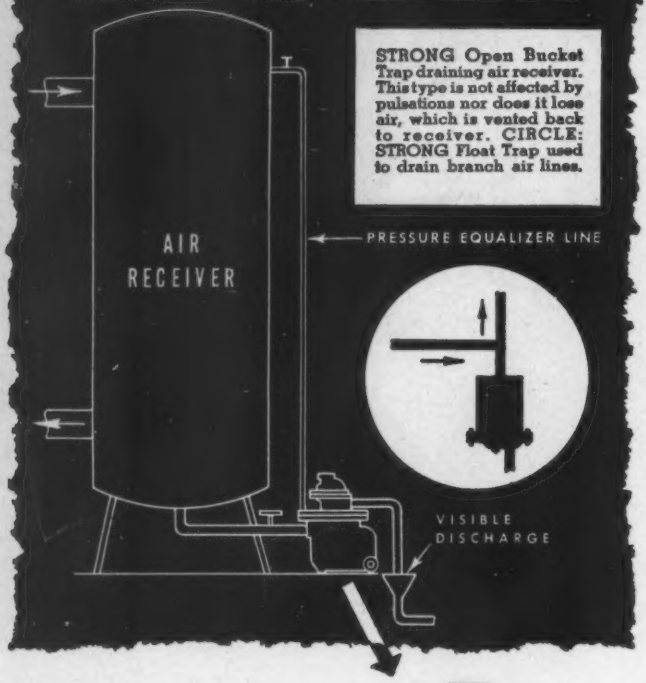
WATSON-STILLMAN

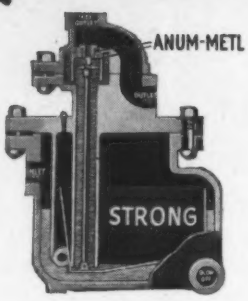
Distributor Products Division

Designers and Manufacturers of Forged Steel Fittings and Valves, and Hydraulic Equipment

For Victory ★★★ Let's all be Scrappers

DRAIN RECEIVERS WITH NO AIR LOSS


STRONG Open Bucket Trap draining air receiver. This type is not affected by pulsations nor does it lose air, which is vented back to receiver. CIRCLE: STRONG Float Trap used to drain branch air lines.
AIR RECEIVER
PRESSURE EQUALIZER LINE
VISIBLE DISCHARGE



Reciprocating compressors cause pressure surges in air receivers. These pulsations tend to "bounce" buckets of inverted bucket traps, resulting in excessive wear of parts, continual discharge and loss of air.

STRONG Open Bucket Traps are not affected by such pulsations. Only the weight of condensate in the bucket causes them to discharge. No air is lost during discharge, and air displaced from the trap by incoming condensate is vented back to the receiver.

This hook-up also is used for draining gas receivers and accumulators. Where liquids other than water are handled, special traps are furnished.

• • •

Completeness of the STRONG lines enables us to recommend exactly the type and size you need—open or inverted bucket, closed float, float-and-thermostatic (blast), etc.—forged, fabricated (welded), cast and semi-steel construction. Send your problems to Strong, Carlisle & Hammond Company, Cleveland 13, Ohio.

STRONG, CARLISLE & HAMMOND CO.

1392 West Third Street • Cleveland 13, Ohio

WAR! Strong Specialties are now needed for war plants (explosives, chemicals, aircraft, ships, etc.). PLEASE CONSERVE present Strong equipment. Use repair parts to restore efficiency . . . increase production . . . save steam (fuel) . . . save money.

443

HANLON-WATERS INC. **H-W** STANDARD FOR PERFORMANCE

24"-125-LB. FLANGED END H-W Type 1586 Butterfly Valve

Multiple spring loaded diaphragm actuated top works with powerful leverage attachment to valve shaft travel indicator with full 90° travel of inner valve. Extra heavy construction of internal valve flapper and shaft to withstand high pressure differentials across valve. Shaft supported on ball bearings to minimize friction. Ball bearings enclosed in grease packed journals with fittings for pressure lubrication.

ASK THE MEN WHO USE THEM!

Information on all HANLON-WATERS Equipment available at representative nearest you.

HANLON-WATERS, INC.

TULSA, OKLAHOMA

New York • Chicago • Pittsburgh • Philadelphia • Boston • Kansas City • Denver • Los Angeles • Mobile • Shreveport, La. • Fort Worth • Houston • Corpus Christi • Amarillo • Odessa, Texas

GATX GENERAL AMERICAN PLATE & WELDING DIVISION PLANT AT SHARON, PA.

Victory

IS OUR ONLY JOB NOW

—but we're planning for YOUR post-war needs

- **Steel plate fabricators**
- **Manufacturers of Class 1 pressure vessels and all other classes of welding**
- **Complete X-ray and annealing facilities**
- **Completely equipped department for field erection**

Plate and Welding Division

GENERAL AMERICAN TRANSPORTATION CORPORATION

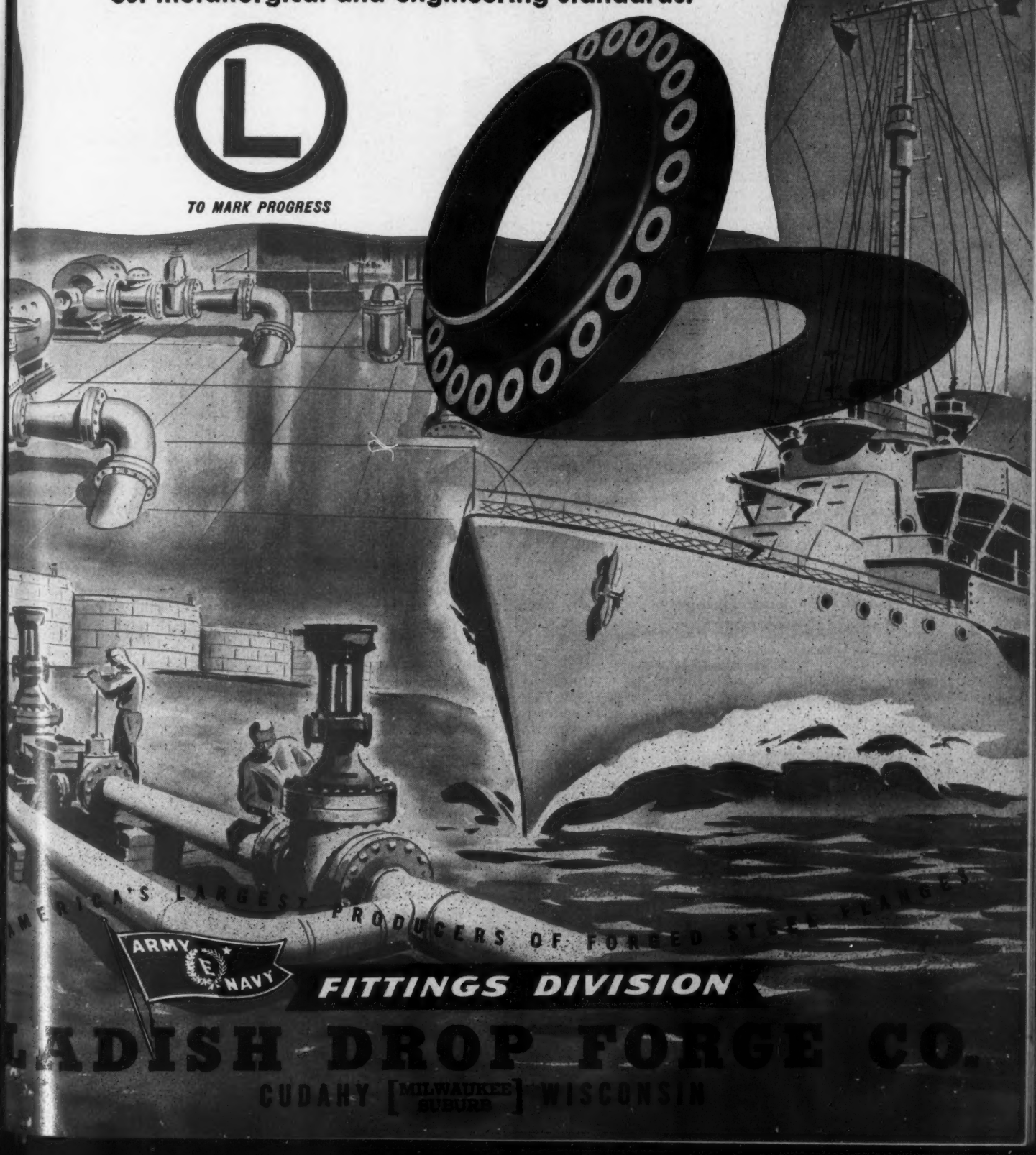
SHARON, PA.

LADISH
forged steel flanges

Connecting the vital arteries of Industry, Ladish flanges are produced under the highest metallurgical and engineering standards.

L

TO MARK PROGRESS



AMERICA'S LARGEST PRODUCERS OF FORGED STEEL FLANGES

ARMY E NAVY

FITTINGS DIVISION

LADISH DROP FORGE CO.

CUDAHY [MILWAUKEE SUBURB] WISCONSIN

NEW EQUIPMENT FOR THE MODERN PLANT

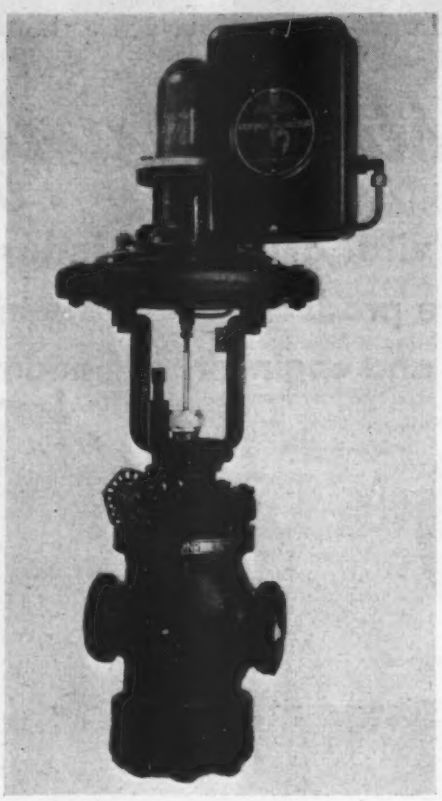
Vernier Valvactor

THE FOXBORO COMPANY

The Foxboro Company, Foxboro, Massachusetts, has announced the new Foxboro Vernier Valvactor, to insure precise and dependable valve response, especially where operating conditions may make the response uncertain, slow, or unsatisfactory. The device is actuated by air pressure changes as slight as the equivalent of ½-inch of water, and can compel valve-stem movements as small as 1/1000 of an inch.

While the same operating principles which have been used in the Vernier Valvactor previously, the new construction involves a completely different arrangement of the actuating elements. New ease and range of adjustment, especially for duplexing and sequencing, and new snap action, for relay service or step sequencing of valves or damper motors, are provided by new, convenient zero and range adjustments. New ease of reversal is provided, without change of parts or piping.

The new unit retains the advantage of relay action. Flexure type bearings, in place of pivots, eliminate the effects of mechanical vibration, without loss of sensitivity. Finally, although the Vernier Valvactor retains the same general external appearance, new ruggedness has been provided for it by a heavier metal case.



A Foxboro Stabilflo Valve equipped with the new Foxboro Vernier Valvactor—a micro-positioner for pneumatic motor valves.

Signalling Timer

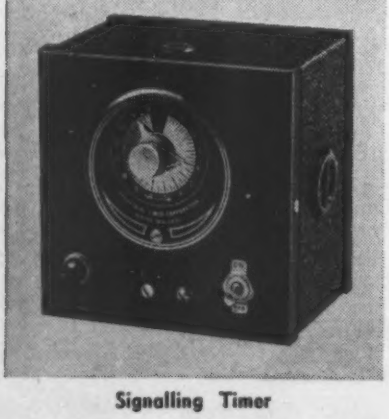
INDUSTRIAL TIMER CORPORATION

Industrial Timer Corporation, 117 Edison Place, Newark, New Jersey, has developed the new Series S, Signalling Timer that provides automatic closing or opening of a circuit at the end of elapsed time, and operates additional buzzers, bells or lights at remote locations.

When the pointer on the timer is manually set to the required interval shown on the dial, a circuit is closed which operates a pilot light indicating that the time interval has started. The moving pointer revolves counter-clockwise toward zero; at any second, during the interval, the exact time elapsed is shown on the dial. When the interval is completed an audible alarm sounds and the pilot light goes out. The buzzer continues to sound until the toggle switch on the timer is snapped to off position or the timing interval is again started, by moving the pointer knob to the required time interval.

A socket on the side of the timer case provides for connection or additional lights or alarms. If a circuit closure is required during the time interval, an easily accessible, readily recognized change-over wire and terminal is provided at the rear of the bakelite timer case. Rapid resetting of the pointer knob, when the same time interval is to be repeated indefinitely, is afforded by a quickly adjustable back stop.

The timer is enclosed in a black metal case, attachable to any wall or panel or standard switch box. The case is 5 x 5 x 3½ inches. The outfit operates on alternating current, 115 to 230 volts; 25, 50 or 60 cycles, 1000 W voltage and frequency to be specified. The motor is slow-speed, self-starting synchronous type. Silver contacts are used throughout. Connection to the line is made with line cord.



Signalling Timer

Compressed Air Cooler

NIAGARA BLOWER COMPANY

Niagara Blower Company, 6 E. 45th Street, New York 17, New York, has perfected the Niagara Aero After Cooler for cooling compressed air or gases generated for industrial use.

This cooler uses the evaporated cooling principle to obtain lower temperatures and the new design gives greatly increased capacity in compact apparatus.

Air, drawn by a fan through a water spray across coils containing the compressed air or gas is the cooling medium and temperatures within 10 degrees of the wet bulb air temperature can be maintained.

Industrial Thermometer

C. J. TAGLIABUE MANUFACTURING COMPANY

C. J. Tagliabue Manufacturing Company, Park and Nostrand Avenues, Brooklyn, New York, has a new industrial thermometer, features of which include a plastic case front, yellow back, easy-reading thermometer tubing and malleable iron back.

By using a plastic case front, weight is reduced. The front is not affected by the temperatures to which the case is subjected under actual service conditions. Either the glass or the entire front can be replaced at nominal cost.

Yellow back lens front thermometer tubing offers the best color contrast with the mercury.

Malleable iron has been found to be an entirely satisfactory substitute metal for the brass formerly used, and is fully protected against corrosion by a durable black finish.

Door Interlock Switch

GENERAL ELECTRIC COMPANY

General Electric Company, Schenectady, New York, announces a new door interlock switch, designed as an emergency device to interrupt control circuits where access doors are opened when the power is on.

It has a carrying capacity of 10 amp, 110 or 220 volts a-c or d-c, and an emergency opening capacity of a-c 7½ amp, 110 or 220 volts; d-c on low inductive circuits, 5 amp, 125 volts; 2½ amp, 250 volts.

Application covers a wide range where doors, windows or covers must be interlocked for the protection of the equipment and safety of the personnel. For example, doors on radio transmitters, X-ray and therapeutic machines, burglar alarms, and signal controls for fire doors.

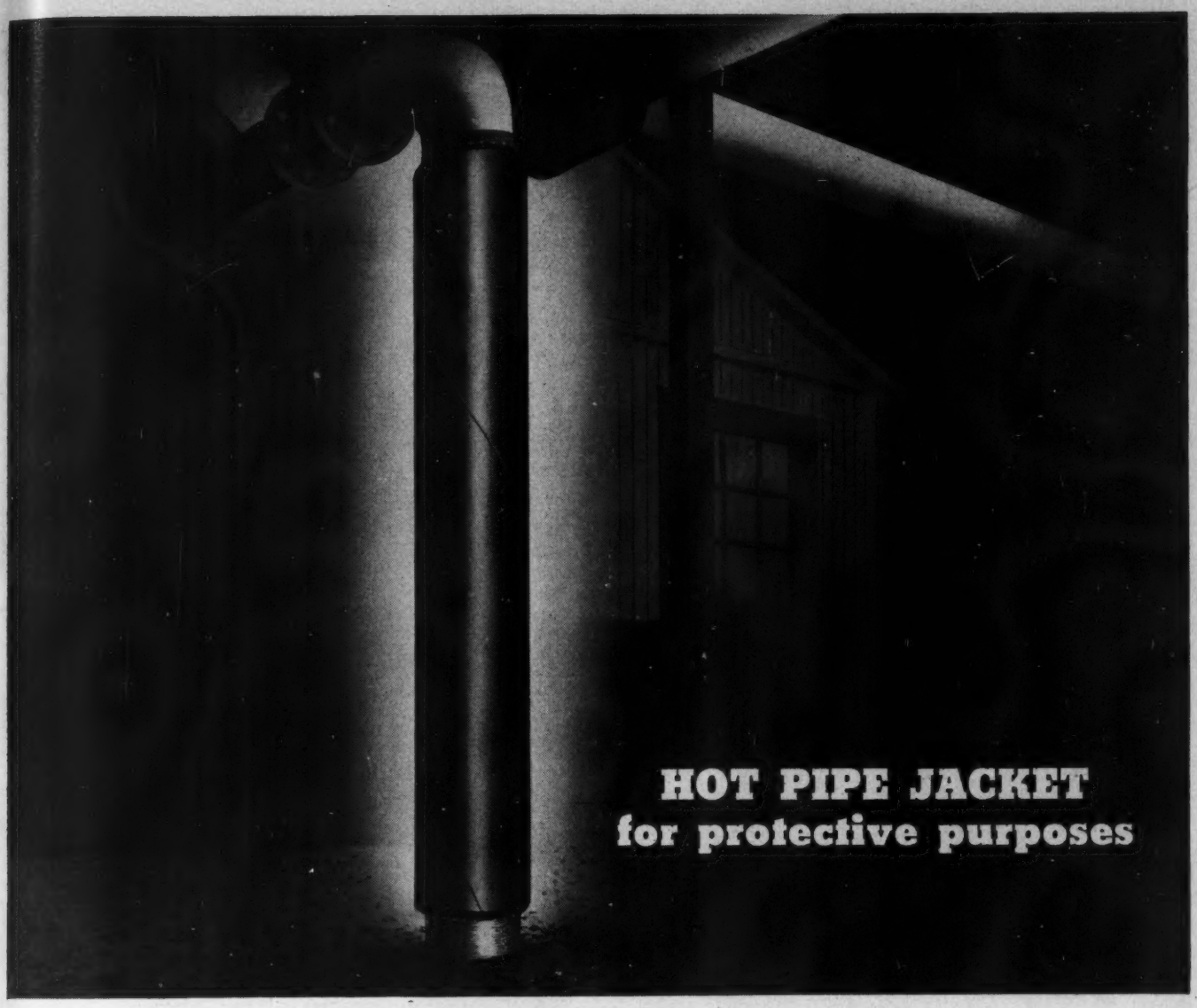
Steam-Jacketed Strainer

BLACKMER PUMP COMPANY

Blackmer Pump Company, Grand Rapids, Michigan, announces a strainer for handling highly viscous liquids or liquids at room temperature.

Standard capacities are 20, 50, 100 and 200 gallons per minute. Pipe sizes are 1, 2 and 3 inches. Threaded connections are provided for the 1- and 2-inch sizes, and the 3-inch has flanged connections. Maximum operating pressure is 50 pounds at temperature of 600° F. The jacket is suitable for 125 pounds steam pressure.

Blackmer Steam-Jacketed Strainer



Information supplied by "Petroleum Refiner"

Protection from hot upright pipes near doors and passageways in refining plants can be provided by covering the process piping with larger lightweight pipe sections.

An effective installation can be made by cutting the protective section with serrated ends. When this section is placed around the smaller pipe, these serrations can be bent inward against the process piping so as to hold the outer piping in position. The serrations also provide space for escape of heat from the inner piping. These installations may be painted or covered with insulation.

Protective piping may be added to units already in place by cutting the larger pipe for its full length and forcing it open sufficiently for inclosing the smaller pipe, after which it can be closed and fitted in place by bending serrated ends.

CLIMAX FURNISHES AUTHORITATIVE ENGINEERING DATA ON MOLYBDENUM APPLICATIONS.

ARMY E NAVY

MOLYBDIC OXIDE, BRIQUETTED OR CANNED • FERROMOLYBDENUM • "CALCIUM MOLYBDATE"

Climax Molybdenum Company

500 Fifth Avenue · New York City

MOLY

TWO YEARS OF CALLING ATTENTION TO SAVING CHROMIUM

This advertisement ran in 1941

SAVE CHROMIUM

HELP NATIONAL DEFENSE

You can save chromium for defense and save money in your own plant by using our Chrom Glucosate. You are wasting chromium, badly needed in our National Defense program, when you use it for corrosion control instead of chrom glucosate.

Look at this table of comparison. It tells a commanding story.

COMPARATIVE CHROMIUM CONSUMPTION USING GLUCOSATES AS COMPARED TO CHROMATES

Amt. in form of Glucosate	Amt. as dichromate	Application	Saving
SODIUM BICHROMATE			
17 pounds	100 pounds	Calcium Brine	83 lbs.
17 pounds	200 pounds	Salt Brine	183 lbs.
34 pounds	500 pounds	Cooling Water	466 lbs.
CHROMIC ACID			
3 pounds	66 pounds	Calcium Brine	63 lbs.
3 pounds	132 pounds	Salt Brine	129 lbs.
10 pounds	330 pounds	Cooling Water	320 lbs.

Furthermore, there are other glucosates that eliminate the need of chromium. Let us send you the whole story.

Help us to stop the waste of chromium ore. Switch to Chrom Glucosate at once and tell your business acquaintances the story of Chrom Glucosate, too.

WATER CONSULTANTS

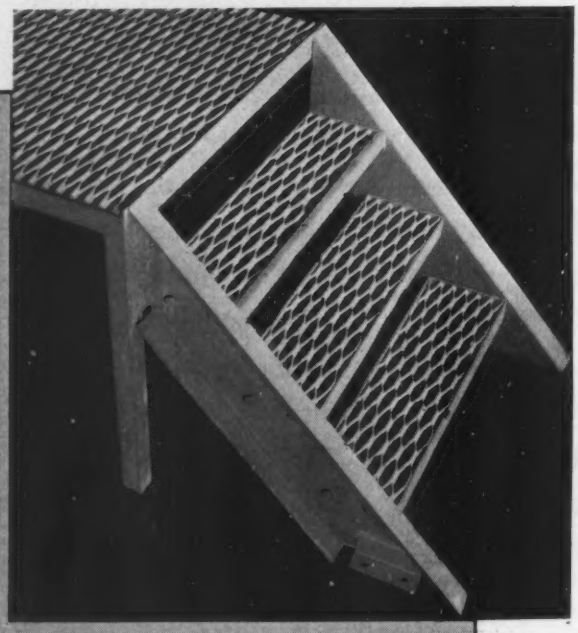
D. W. HAERING & CO., INC.

GENERAL OFFICES: 205 West Wacker Drive

CHICAGO, ILLINOIS

Steelcrete

EXPANDED METAL *For All Purposes*



THE CONSOLIDATED EXPANDED METAL CO'S

WHEELING, WEST VIRGINIA

Offices in Principal Cities • It's Wheeling Steel!

Buoyancy Type Liquid Level

TAYLOR INSTRUMENT COMPANIES

Taylor Instrument Companies, Rochester, New York, announce a new buoyancy-type level-buoy which both controls and indicates liquid level. The instrument employs the Taylor Fulscope control mechanism with either completely adjustable sensitivity for smooth throttling level control, or automatic re-set for averaging of liquid level with a minimum of disturbance to the process.

Taylor Level-Buoy

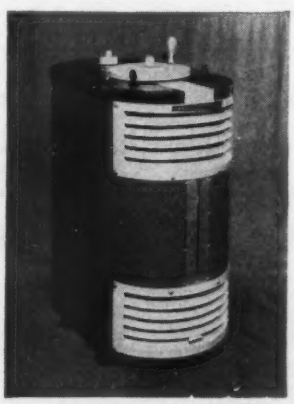
Level changes are transmitted to the instrument mechanism by a torque tube. This gives a closed system which eliminates leakage. The torque tube is interchangeable with the ones used in Taylor Aneroid manometers which is an advantage to instrument users in minimizing inventories of spare parts.

Liquids with specific gravity range between .2 and 2.0 can be handled with the level. It is available in the following standard ranges: 14, 32, 60, 72 and 120 inches.

Outdoor Welding Outfit

GENERAL ELECTRIC COMPANY

General Electric Company, Schenectady, New York, has developed a 500-ampere outdoor alternating-current welder with welding current range from 100 to 625 amp at 40 volts. The outfit was especially designed for outdoor locations where exposure to the weather is encountered.



GE Outdoor Welding Outfit

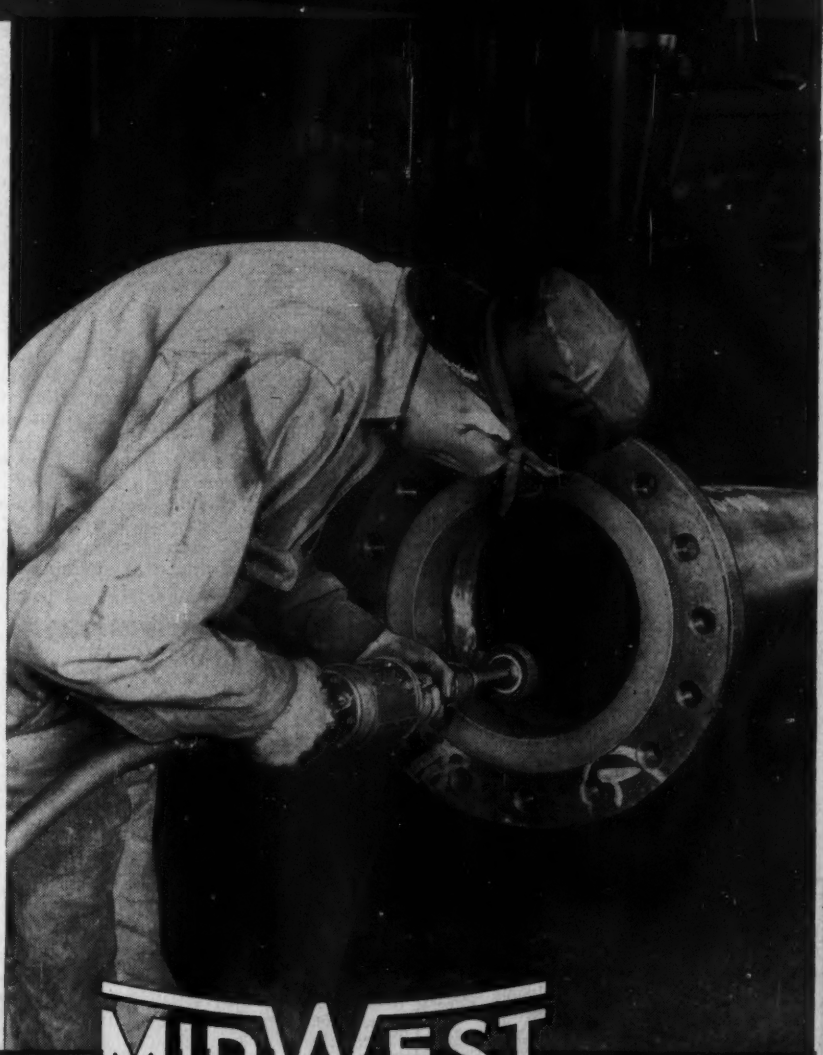
A feature of this welder is an "idlematic" control which automatically reduces the output voltage to less than 35 volts whenever the arc is not in operation, but provides full power for welding the instant the arc is struck. This control also includes a switch operated by

THOROUGH CLEANING

. . . another advantage of

MIDWEST

PRE-FABRICATED PIPING



Piping subassemblies that are prefabricated by Midwest are thoroughly cleaned before leaving our various plants. All scale, dirt and other accumulated impurities that otherwise would cause serious damage to valves, turbine blading, etc. are removed.

You do not have to waste time in cleaning Midwest Pre-Fabricated Piping . . . it is delivered ready to erect. The careful checking in our shops to make sure dimensions and alignment are correct . . . the searching inspection and shop testing . . . are other important time-saving advantages of Piping by Midwest.

• • •

Midwest Piping Service can be used to advantage whenever you need piping . . . whether a simple pipe bend or a complex high pressure piping job. Three modern fabricating plants are strategically located to serve you . . . and an experienced Erecting Division will take full responsibility for a complete piping installation.

MIDWEST

PIPING & SUPPLY COMPANY, INC.

Main Office: 1650 South Second St., St. Louis 4, Mo.

Plants: St. Louis, Passaic (N. J.) and Los Angeles

Sales Offices: Chicago—[illegible] • Houston—[illegible] • Los Angeles—[illegible] • New York—(Eastern Division) [illegible] • Tulsa—[illegible]

Now! ELECTRONIC
Volume Control
for Milton Roy Chemical Pumps
• Employs electron tubes to convert a-c to controlled d-c.
• Affords simple, wide-range speed control for the operation of d-c motors from a-c power lines.
• Performs additional functions of starting, accelerating, motor protection and dynamic braking.
• Allows you to select motor speed during operation or to preset speed before starting.
A-C
TRANSFORMER
ELECTRONIC CIRCUITS
START
STOP
SPEED CONTROL
D-C
MILTON ROY PUMPS

This new Electronic Volume Control system is now available with Milton Roy Pumps. The equipment is simple, compact, complete. It may be manually operated or is adapted for automatic operation by means of other electrical circuits in conjunction with flow meters or other control instruments.

It provides single-dial speed control, plus start and stop buttons . . . positive, stepless, motor acceleration . . . precise volume control in pumping chemicals . . . from a single station most conveniently located.

Bulletin 4311, now ready, contains complete description. . . . Write for it.

Consult with Milton Roy engineers on any problem having to do with pumping chemicals in precisely controlled volume at discharge pressures up to 20 thousand pounds per square inch. It will help us make recommendations and quote prices if you will state

- Capacity required in gallons per hour.
- Discharge Pressure in lbs. per sq. in.
- Material to be pumped.
- Percentage of concentration.
- Operating Temperature.
- Motor characteristics.

MILTON Roy PUMPS
1383 E. MERMAID AVE., CHESTNUT HILL, PHILA. 18, PA.

a handle extending through the top of the case for starting or stopping the welder manually.

The welder is protected against the entrance of rain, snow and sleet by dripproof construction of all openings in the top of the case and by a sealed window over the current indicator. Wide louvers serve not only to shed water but to keep air velocity low. All internal parts have a special finish for protection against corrosion from moist air.

In addition, the welder is provided with all the features incorporated in indoor a-c welders of this type. These include built-in power-factor improvement which provides low current input by maintaining the power factor at 95 per cent or better at all loads between 40 and 70 percent of rating. They also include finger-tip adjustment, stepless current control, fan-forced ventilation, and capacity for operation with long leads.

Metal Paint Primer

TURCO PRODUCTS, INCORPORATED

Turco Products, Incorporated, 6135 South Central Avenue, Los Angeles, California, has developed a new paint primer said to assure permanent adhesion on galvanized metal with no chipping or peeling.

Through chemical action this paint displaces the slick, oily surface typical of galvanized metal with a roughened, "toothy" surface to form a tight bond with the paint. It also neutralizes the alkalinity and passivates the metal, forming an inactive film which will not become alkaline and which is resistant to corrosion.

Another feature, color control, results in a dark tint on areas properly treated, leaving the untreated area conspicuously bright, making it possible to determine almost instantly which sections have been covered with the paint.

Application is by hand or by tank immersion. When applied by hand, the paint is wiped on full strength, or diluted with water, with a sponge or rag. When the proper color develops, surplus liquid is squeezed off and the surface wiped with clean, dry cloths.

Fatty Acid Derivatives

EMERY INDUSTRIES

Emery Industries, Cincinnati, Ohio, announced recently the availability of two new and unusual derivatives of animal fatty acids.

The first of these, Azelaic Acid, is described as a dibasic aliphatic acid, having a nine-carbon chain with carboxyl groups at each end. Its melting point is given as 96°C. Several examples of its reactions are given, laying emphasis upon its ability to form soft alkyd resins with glycerine and other suitable polyhydric alcohols. It is said that in general, the esters of Azelaic Acid have higher boiling points than those of fatty acids of corresponding molecular weights. This characteristic is pointed to as suggesting their use as plasticizers.

The second development is described as a series of low molecular weight, monobasic acids, in which the unusual nine-carbon acid, Pelargonic, predominates. The properties of this acid are described along with many of its characteristic reactions. Again the esters are described in detail because of their application to the oil modification of alkyd resins with which it is said they are quite compatible.

YOUR ANSWER for speeding wartime MAINTENANCE

Salvaging Valves the FAST Oakite Way!

Because of the prevailing difficulty in obtaining new replacement parts, you cannot afford to discard muck-encrusted valves, fittings, piping or other parts. Nor is there any need to do so! Salvaging these parts the FAST, EASY Oakite way will help make most of them GOOD AS NEW!

Just soak parts in recommended Oakite degreasing solution. You'll find ALL oil, grease and muck have been thoroughly softened and loosened so that deposits are usually "knocked off" with a pressure-rinse. Parts are left in excellent condition for QUICK inspection and EASY repair!

Data FREE on Request

Let us show you how you can save time, conserve effort on this and such other jobs as drum washing, paint stripping and steam cleaning. Write today! No obligation, of course!

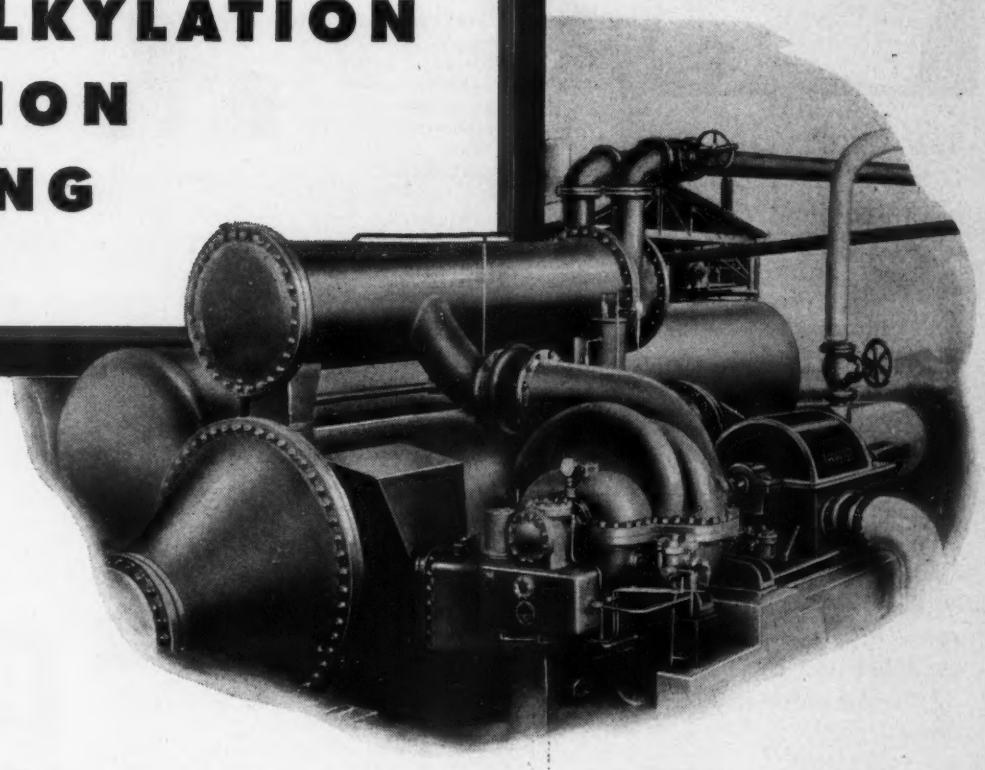
OAKITE PRODUCTS, INC.
50B Thames St., New York 6, N. Y.
Technical Service Representatives Located in All Principal Cities of the United States and Canada

OAKITE Specialized CLEANING

Buy Bonds for Victory

Engineered...

FOR ALKYLATION REACTION COOLING



The Alkylation Process in its growing list of installations . . . built, building and planned . . . has reasons for sound confidence in the refinery-type Centrifugal Refrigeration Compressor of Worthington design.

Performance of this equipment in the pioneer alkylation plants bears out the engineering considerations on which its choice was predicated. Worthington experience in collaboration with refinery engineers has again stood the industry in good stead.

From the operating point of view, attention may be called to the economy and control-flexibility of direct-connected steam turbine drive — and, incidentally, to the unified responsibility inherent in the fact that Worthington builds both the Worthington centrifugal compressor and the Worthington-Moore steam turbine.

Our engineers will be glad to provide interested engineers with all possible details on this refrigeration equipment.

Worthington Pump and Machinery Corporation,
Refrigeration and Air Conditioning Division,
Harrison, New Jersey. CA3-41

WORTHINGTON

Refrigeration

AND AIR CONDITIONING EQUIPMENT

SMOOTH-ON
REPAIR
RECORDS
Repair of Cracked Oil Base
This SMOOTH-ON repair was made by using patch plates over the cracked area. SMOOTH-ON was applied between each plate and the cracked surface. The plates were pulled together by bolts.
FOLLOW THIS SERIES OF SMOOTH-ON SAVINGS

This SMOOTH-ON application is typical of the simplicity and effectiveness of repairs made with SMOOTH-ON No. 1.

SMOOTH-ON can also be used for many other kinds of repairs, such as sealing cracks in castings, stopping leaks at pipe joints and seams of tanks and other apparatus, and tightening loose brackets, fixtures, and parts of equipment.

Today, when replacements are so hard to get, SMOOTH-ON is more of a plant necessity than ever before. Buy a can today . . . it will come in handy many times.

Buy SMOOTH-ON in 7-oz., 1-lb., or larger containers from your supply house, or if necessary from us. For your protection, insist on SMOOTH-ON, used by engineers and repair men for over 45 years.

FREE

REPAIR HANDBOOK SHOWS HOW

40 pages, 170 diagrams, and simple concise instructions for practical repairs to plant equipment, pipe lines and structures. A necessity in every plant. Your copy sent FREE if you fill in and return the coupon.

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Do it with **SMOOTH-ON**
The Iron Repair Cement of 1000 Uses

☆ BUSINESS NOTES ☆

John E. Slaughter, Jr., Promoted by Girdler

Announcement was made recently of the election of John E. Slaughter, Jr., to the vice-presidency of the Votator division of Girdler Corporation, Louisville, Kentucky. For the last five years he has been sales manager.

J. E. Slaughter, Jr.

Starting in the New York office in 1934 as a salesman, Slaughter gained his first experience with Votator in its application to the ice cream industry.

He is a graduate of Male high school in Louisville, and of the University of Virginia.

Ross Heater Opens San Francisco Office

Ross Heater & Manufacturing Company, Buffalo, New York, has opened a factory branch office, 703 Market Street, San Francisco, under direction of Richard N. Mathews. Mathews was transferred to the Pacific Coast from the Chicago office, and has been with the company 10 years, except for a recent period with the War Production Board in Washington. Ross equipment is also handled on the Pacific Coast by R. D. Morse, Seattle, Washington, and W. S. Turner & Company, Portland, Oregon.

R. N. Mathews

Cutler-Hammer Announces New Manager for New York Office

W. E. Addicks has been appointed manager of the New York office of Cutler-Hammer, Incorporated, and will have charge of sales in all of the New York sales territory. He entered the employ of Cutler-Hammer in 1914 immediately after graduation from Cornell, and for ten years served as chief engineer at the New York works. Prior to his new appointment, he was in charge of the Boston sales office.

Bertram General Manager Heat Transfer Products

E. A. Bertram has recently been appointed general manager of Heat Transfer Products, Inc., 90 West Street, New York. He was formerly chief engineer of the Heat Exchanger Department of Lummus Company, and before that was connected with Alco Products Company and Shell Oil Company. He is a graduate of the University of Illinois and also received an M.S. in Chemical Engineering from the California Institute of Technology.

E. A. Bertram

Heat Transfer Products, Inc., also announces that Harry W. Parsons Company, San Francisco, has been authorized as representative in the sale and service of its equipment.

McColl Is Elected Director of American Locomotive Company

Robert B. McColl, vice president of manufacturing of the American Locomotive Company was recently elected a director of the company. He was born in 1882 at Kilmarnock, Scotland, where he attended the Kilmarnock Academy and the Science and Art College. After serving a special apprenticeship and working in various departments on the Glasgow & Southwestern, he was employed by Robert Stephenson & Sons, locomotive builders, Darlington, England, as draftsman. In 1905 he went to the Montreal Locomotive Works, Ltd., Montreal, Canada, serving in several departments until he became assistant superintendent, superintendent of works, and finally works manager. In 1917 he was appointed manager of the muni-

R. B. McColl

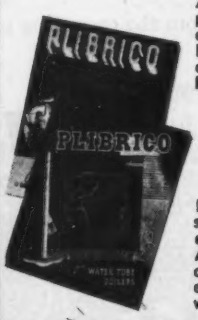
PLIBRICO
Jointless **FIREBRICK**

The Answer to Your Refractory Problems!

FOR boilers and stills—for patching and repairs—for entire walls and complete relining—Plibrico Jointless Firebrick is the dollar-saving, trouble-saving refractory that refineries everywhere are adopting.

Plibrico forms a solid, monolithic lining that eliminates the weak joints of laid-up fire brick construction. Flexo-Anchors prevent bulging. No special shapes are required; Plibrico comes in moist, plastic form and can be readily moulded to any shape. Your own maintenance men can install it or we furnish complete installation service.

For extreme conditions, there is the Plibrico sectionally-supported air-cooled wall. And the Plibrico suspended arch for boiler arches and still roofs. Both are erected without special tile or heavy castings.



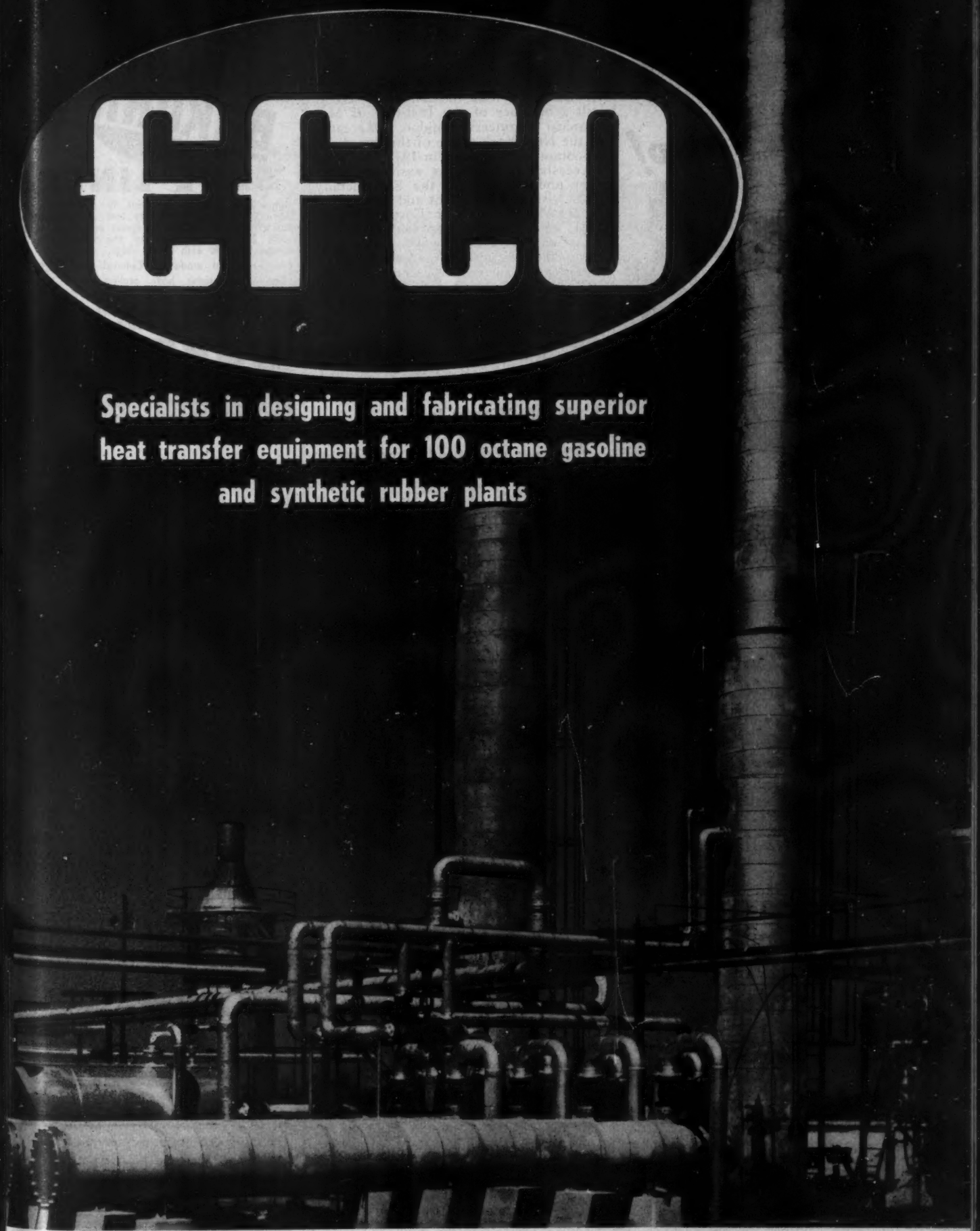
These catalogs cover your requirements.

Here is the complete story of Plibrico linings, arches, air cooling, etc. Ask for your Plibrico catalog. Specify whether operating H.R.T. or water tube boilers.

PLIBRICO JOINTLESS FIREBRICK CO.
1803 Kingsbury St., Chicago, Illinois

EFCO

Specialists in designing and fabricating superior heat transfer equipment for 100 octane gasoline and synthetic rubber plants



ENGINEERS & FABRICATORS, INC.

P. O. BOX 7395 — EFCO — HOUSTON, TEXAS

Fire cannot burn without air. With swift efficient action C-D/Fog completely surrounds fire with a blanket of carbon dioxide. *Air is sealed out.*

C-D/Fog is especially recommended for oil, gasoline, electrical, or chemical fires. Built by General Detroit, manufacturers of fire protection equipment since 1905, C-D/Fog comes from a distinguished line of fire fighters, including such famous names as Fire Guard, Alaskan, and Floafome. Like all General products, it is quality mass produced for prompt delivery to essential users.

Find out about C-D/Fog today! Mail the coupon and details will be rushed!

THE GENERAL DETROIT CORP.

Former Name The General Fire Truck Corp.

NEW YORK DETROIT CHICAGO

Distributors in all principal cities

West Coast Affiliate: The General Pacific Corp., Seattle, Los Angeles, San Francisco.

THE GENERAL DETROIT CORP.
2222 East Jefferson Ave., Detroit 7, Mich.
SPEED complete details to:

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Just attach this convenient coupon to your letterhead and mail.

tions department of the Eddystone Munition Company, where he served until after the Armistice. Returning to England he became general manager of Armstrong Witworth Company. He is still a member of the Institute of Mechanical Engineers, London. He came to the New York office of the American Locomotive Company in 1922. He held successive positions as assistant manager and manager of the Schenectady plant. Elected president and director of McIntosh & Seymour Corporation in 1931, he became vice president of the diesel engine division when that corporation merged with its parent company, American Locomotive Company. In 1936 he was elected president of Alco Products, Inc., and became vice president of the American Locomotive Company, Alco Products division, when that division merged with the parent company. He became vice president of manufacturing of American Locomotive in 1940.

J. Handly Wright Is New Monsanto Director

J. Handly Wright is the new director of the department of industrial and public relations of Monsanto Chemical Company, St. Louis. He will have charge of advertising, public relations, industrial and labor relations, and company publications. For the past 4½ years Wright has served as executive vice president of Associated Industries of Alabama. Prior to this time he was with assistant director of public relations for the National Association of Manufacturers for four years. He was a partner in the public relations firm of Fred L. Palmer and J. Handly Wright from 1932 to 1935, and was a member of the staff of Ames & Norr in New York from 1929 to 1932. Wright spent three years with the Associated Press as reporter, wire editor and bureau chief in several Eastern and Southern cities. He also worked on a number of newspapers. He is a native of Nashville, Tennessee, and was educated at Vanderbilt University.

Refractory & Insulation Opens Cleveland Office

Refractory & Insulation Corporation, New York, has opened a new sales office at 648 Hanna Building, Cleveland 15, Ohio, under the direction of Ernest A. Weber. Weber, a graduate in architecture and a former president of the Architectural Engineering Alliance of Westchester County, New York, has had extensive experience in the application and engineering of insulation and refractory materials.

Hooker Company Announces Several Promotions

Hooker Electrochemical Company, Niagara Falls, New York, announces the following promotions and new appointments in its sales departments:

Robert E. Wilkin, Eastern sales manager; Lauren B. Hitchcock, manager of sales development; S. I. Anderson, assistant Eastern sales manager; S. F. M. Maclaren, assistant Eastern sales manager; G. F. Reale, special sales supervisor; Wm. F. George, New York District sales supervisor; George J. Bruyn, office manager, Niagara sales department; Wm. H. Monsson, Midwestern sales supervisor.

Wilkin, the new sales manager for the Eastern division, with headquarters at

BAKOGRAPH BAKORINGS
SAVE LINERS

Non-scoring plastic material is practically self-lubricating, hence temporary loss of lubricant will not affect the life of the liners or piston. Grit or scale become embedded in the plastic. Do not scrape liner as with metal rings.

Basic material made by General Electric Co.

Leading companies have proved lower cost per hour of service.

QUICK DELIVERY . . . WRITE FOR FOLDER AND PRICES

BAKORING
INCORPORATED
1020 HOUSTON AVENUE
HOUSTON, TEXAS

SPECIFICATIONS for a GOOD COOLING TOWER TREATMENT

1. Kill existing algae (all types).
2. Prevent future growth of algae.
3. Inhibit Corrosion.
4. Prevent scale formation.
5. Slowly remove scale and corrosion now in system.
6. Adaptable to filtration or "sludge" settling.
7. Simple color test for correct proportioning of chemicals (adaptable to automatic photo-electric proportioners).
8. PH control.
9. Manufacturers' laboratory service.
10. A 100% chemical compound.

Write . . . Wire . . . Phone

CHEMICAL COMPOUND CO.
2911 RUSK AVE. P. O. BOX 2222
HOUSTON, TEXAS

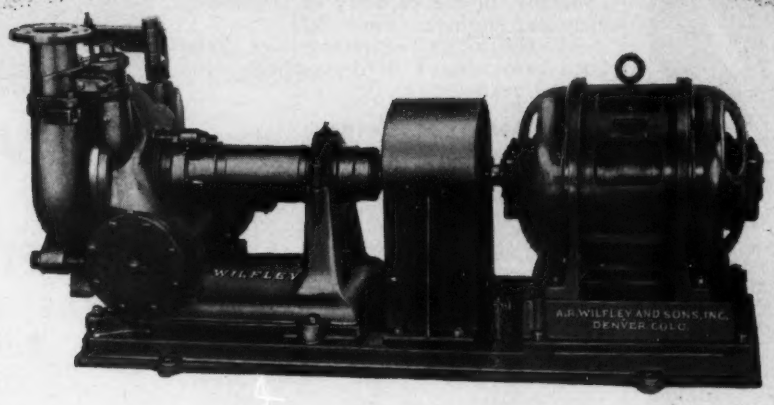
QUICK REPAIRS ON CONDENSERS and HEAT EXCHANGERS

If you need condenser or heat exchanger repairs **in a hurry** call us. We specialize in fast, high quality work.

25 Years Successful Experience

GULF ENGINEERING CO., INC.
"Service, Not Promises"
307 M & M BUILDING HOUSTON, TEXAS
916 S. PETERS STREET NEW ORLEANS, LA.

FOR BASIC PUMPING JOBS



Where a Week is *168* Hours Long!

In plants where pumps must run night and day for months on end–there you'll find WILFLEYS; doing their job smoothly and efficiently; keeping production UP... keeping costs DOWN. Exclusive features of design and construction, plus correctly engineered application, make the High Efficiency WILFLEY a pump you can count on to establish new records for never-failing dependability. Heavy pumping parts of rubber, alloy iron, alloy steel–engineered to your exact requirements. Prompt shipment of parts . . . Write or wire for details.

A. R. WILFLEY & SONS, Inc., Denver, Colorado, U.S.A.

NEW YORK OFFICE: 1775 Broadway, New York City

WILFLEY

centrifugal PUMPS

VICTORY . . .
AND LIBERTY

It's Time to Make
Postwar Plans

Victory by our Armies means new liberty for Postwar activity. Manufacturers and municipalities then can, and will be expected to go ahead with plans of progress.

Those new plans will unquestionably include Wells and Pumps to supply an adequate amount of water—water that can be produced at exceptionally low cost. The Layne Organization has foreseen and made many plans for the days of Postwar. Highly improved designs—some of which were evolved to solve critical war needs, will be instantly available for factories and cities throughout the Nation.

Layne Well Water Systems have long enjoyed absolute superiority in highest efficiency. They have established and maintained thorough dependability. Their quality has been proven by nearly three quarters of a century of service. They are better built today than even before.

For Postwar Water System planning, write for illustrated literature on Layne Pumps and Layne Well Water Systems. Address, Layne & Bowler, Inc. General Offices, Memphis 8, Tennessee.

AFFILIATED COMPANIES: Layne-Arkansas Co., Stuttgart, Ark. ★ Layne-Atlantic Co., Norfolk, Va. ★ Layne-Central Co., Memphis, Tenn. ★ Layne-Northern Co., Mishawaka, Ind. ★ Layne-Louisiana Co., Lake Charles, La. ★ Louisiana Well Co., Monroe, La. ★ Layne-New York Co., New York City ★ Layne-Northwest Co., Milwaukee, Wis. ★ Layne-Ohio Co., Columbus, Ohio ★ Layne-Texas Co., Houston, Texas ★ Layne-Western Co., Kansas City, Mo. ★ Layne-Western Co. of Minnesota, Minneapolis, Minn. ★ International Water Supply Ltd., London, Ontario, Canada.

LAYNE
WELL WATER SYSTEMS
DEEP WELL PUMPS

Builders of Well Water Systems for every Municipal and Industrial Need

Niagara Falls, has been associated with the company since 1936, as assistant sales manager for organic products.

Dr. Lauren B. Hitchcock, manager of sales development, with headquarters also at Niagara Falls, has been with the company, in the capacity of consulting chemical engineer, since 1935.

All the other representatives have been associated with the company for several years.

H. M. Gwyn, Jr., Joins Attapulgus Clay Company

H. M. Gwyn, Jr., has joined the technical division of Attapulgus Clay Company. He will work in the field of contact and distillation treatment of aviation lubricating oils and waxes, and the filtering and purification of oils going into soaps, shortening and paints. Gwyn graduated in chemistry at the University of Pennsylvania in 1936, and then became associated with the Filtrol Corporation in laboratory and sales development work in petroleum, vegetable and animal oil technology. He was made assistant to the sales manager there in 1938, and became Eastern manager in 1941. He is a member of the American Chemical Society and the American Oil Chemists Society.

Staynew Filter Changes Name To Dollinger Corporation

Staynew Filter Corporation, Rochester, New York, will henceforth be known as Dollinger Corporation, taking this name from Lewis L. Dollinger, president and founder of the company.

Recently expanded manufacturing facilities have made possible the development of new products which are soon to be announced. Since certain of these are products other than filters, it seemed advisable to change the company name to one of a more general character.

Dunkley Has Charge of New Blackmer Pump Office

B. Dunkley has been placed in charge of the new office of Blackmer Pump Company, Commercial Trust Building, 15th. and Market Streets, Philadelphia.

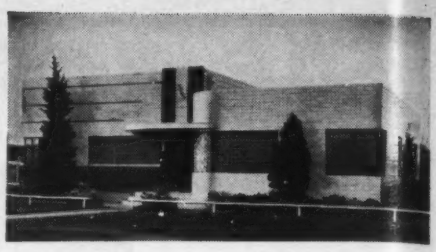
The area served by the new office will include eastern Pennsylvania, southern New Jersey, and a part of Delaware.

Cooper-Bessemer Opens Third Pacific Coast Office

The Cooper-Bessemer Corporation, Ohio, has opened a third Pacific Coast factory branch office, located at 401 Rust Building, San Francisco, California. The other two offices have long been established in Los Angeles, California, and Seattle, Washington.

F. S. Curtis Elected Vice President of Monsanto

Francis J. Curtis was recently elected a vice president of Monsanto Chemical Company. In his new position he will be in charge of Monsanto's long range program of development here and abroad, including general research and sales development. Curtis was born in 1894 in Cambridge, Massachusetts, and graduated from Harvard University in 1915 with a B.A. degree in chemistry. He joined the research department of the Merrimac Chemical Company, which was absorbed by Monsanto in 1929, and worked in production and sales departments. In 1930 he was promoted to director of development for Merrimac, later attaining that position for Monsanto. He



VALVES
and
FITTINGS

STEEL & CAST IRON

Reconditioned
Guaranteed

**Immediate Deliveries
No Priority Needed —
Complete lines — all types and pressures offered for immediate delivery.**

Write, wire, or phone

Refinery Equipment, INC.

UNION AVE. AT 21st STREET
TULSA, OKLA.

WANTED

Engineer experienced in the rating and mechanical design of oil and gas separators for the petroleum industry.

Experienced heat exchanger rater and designer for oil refinery and chemical plant equipment for the petroleum industry.

Permanent positions with a well-established, growing firm located in the East Texas-North Louisiana area. Give complete information in first letter, including education, experience, age, draft status. If your qualifications fill the bill, conference will be arranged at our expense. Address: 301 City Bank Building, Shreveport 23, Louisiana.

(Those now engaged in essential war work at their highest skill not solicited.)

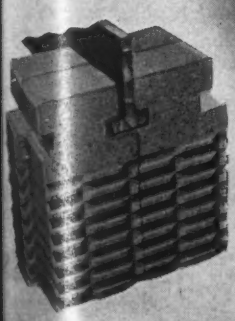
Keeping it within bounds . . . directing it where its power can be used most effectively . . . that has been the business of the Detrick organization for the past 30 years, designing and building walls and arches which would stand a high temperature and severe furnace conditions. As each new problem was presented by industry, Detrick found a practical way to meet it until today thousands of furnaces are serving industry and all of its branches equipped with

DETRICK SUSPENDED ARCHES AND WALLS

It is because of the application of sound engineering principles which Detrick has learned from practical experience, that their arches and walls give such long, economical service. One of these principles is the Detred Tile with treads on all four sides which hold the wall together vertically and horizontally and serve to keep it airtight during its long life. A method of sectionally supporting walls, so that the load is transferred from the tile to metal supports, also contributes to the economy in maintenance.

There is a Detrick construction especially suited for each type of furnace —for steam boilers, for oil heaters, for steel heating furnaces, etc. Each has its own problems which are met by a type of Detrick construction.

The results of these thirty years of experience have been gathered together in what is practically a textbook on the subject of enclosing heat. With charts, photographs, drawings and illustrations the engineer can bring himself up to date on this important subject. If you have a furnace problem, now, or one in the future we shall be glad to send you a copy of this booklet on request. Ask for DETRICK FURNACE ENCLOSURES.



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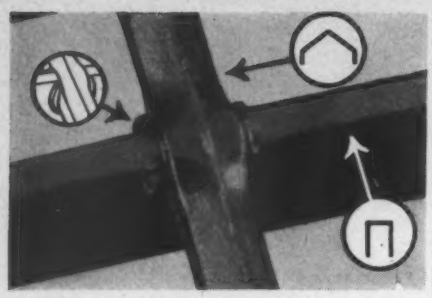

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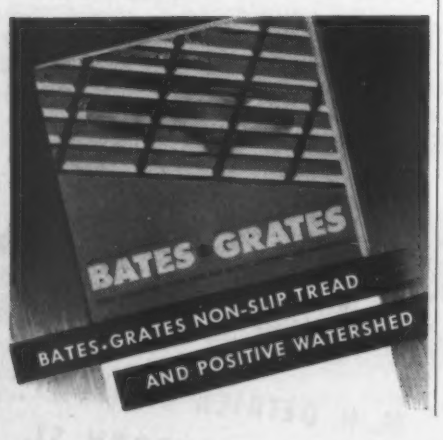

is a director of the American Institute of Chemical Engineers, a member of the American Chemical Socety, and a member of the executive committee of the American section of the Society of the Chemical Industry.

Steinkamp to Lecture on Automatic Control

W. H. Steinkamp, assistant general sales manager of The Brown Instrument Company, a division of Minneapolis-Honeywell Regulator Company, will give a series of talks on the practical aspects of automatic control, this winter. The first of these lectures was on November 19, before the Engineers Club of Detroit, Michigan.

All the talks will be divided into four sections, the first to deal with the elementary theory of automatic control, together with a general classification of industrial control mechanism. The second section will cover a detailed description of air-operated control mechanisms; the third section, electric control mechanisms, and the final section will deal with practical application of control equipment as it applies to various industries and processes.

Mr. Steinkamp expects to give his talks before various engineering groups in different parts of the country. He also expects to appear before various groups of technical members of private companies.

Refinery Supply Company Sums Up Its History

The Refinery Supply Company, Tulsa, has commemorated 25 years of service to the petroleum industry in a booklet giving an informal word and picture sketch of some of the developments which have marked the period. It also traces a parallel history of highlights in the story of oil from 1918. In that year World War I was drawing to an end. Mid-Continent crude oil prices were fixed at $2.25 a barrel. Priorities had been applied to oil-field equipment and equipment prices were fixed. Spy rumors and sabotage were frequent. Gasoline consumption outstripped refinery runs by an average of 1,100,000 barrels per month, and attempts were made to curtail needless "joyriding" and to find "something else" to clean clothes. Aviation gasoline specifications first showed up on a government request for bids, with a total call being made for less than 60,000 barrels, specifications being lower than those of today's ordinary motor gasoline. During this year, W. A. Schlueter of The Refinery Supply Company applied for patents covering the first control application ever designed for vapor outlet control towers, which since has become the principal control application in petroleum refining.

Revolutionary events in refining techniques followed the war. Then came the day of the scientist and laboratory technician, the race for production among such nations as Poland, Germany, Russia, Hungary, Portugal, Morocco, Egypt, and the rapid growth of our national network of natural-gas pipe lines. By 1935 chemists claimed 300 petroleum products with thousands of uses, synthetics derived from petroleum first appeared, and hundreds of shiploads of oil field scrap were being sold to Japan. In 1940 Japan imported 24,000,000 barrels of crude oil and refined products from the United States alone. When war began again the immediate and critical need of a fighting-grade

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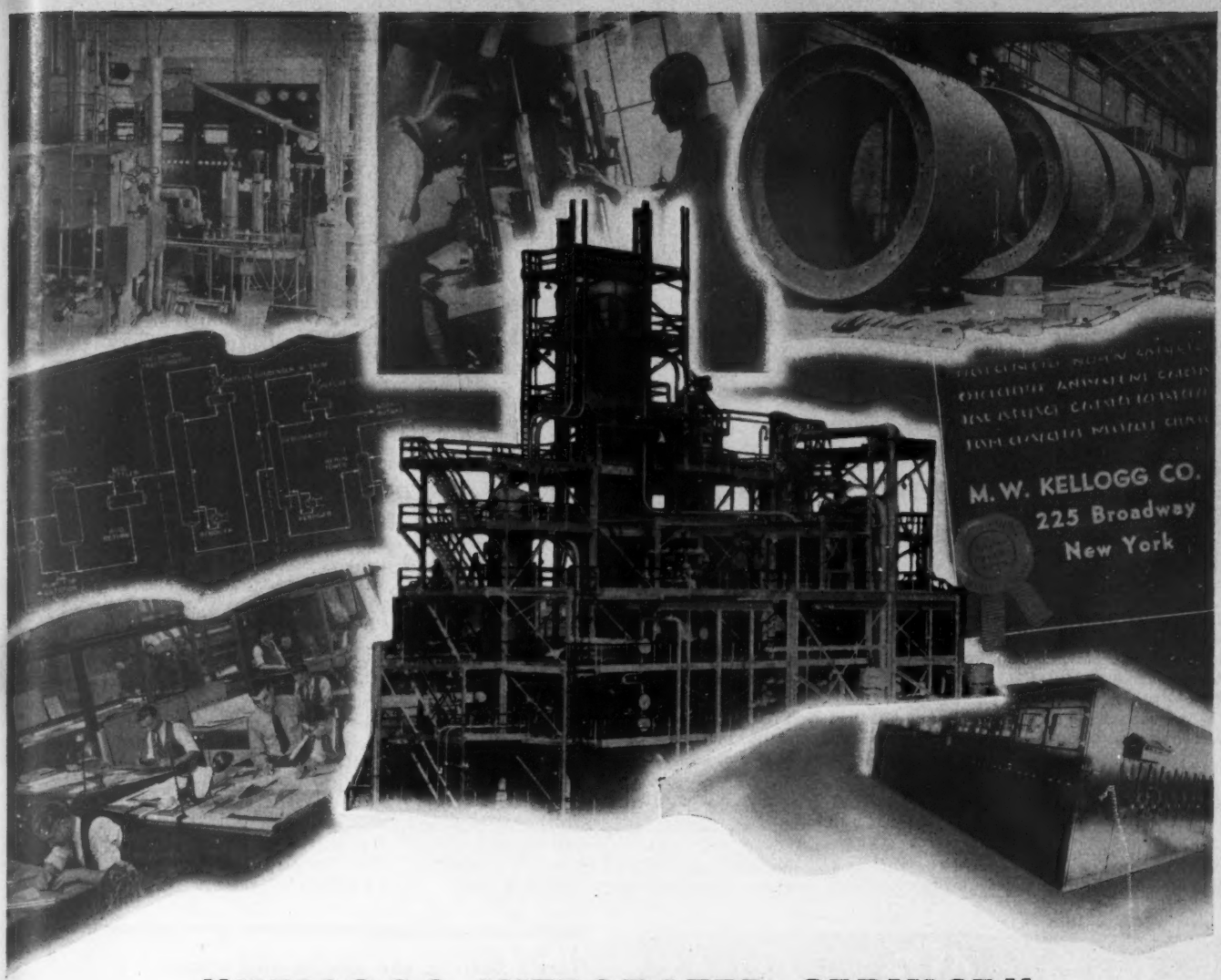

"KELLOGG INTEGRATED SERVICE" Built This Plant

Before erection began, Kellogg Engineers, skilled in basic chemical engineering processes and backed with years of work in practical research plus experience in converting laboratory and pilot plant experiments into commercial successes, had analyzed this particular refiner's problems.

The refiner assures himself of a successful plant by utilizing Kellogg's Integrated Service because all the varied functions of the engineer-contractor are concentrated within one organization.

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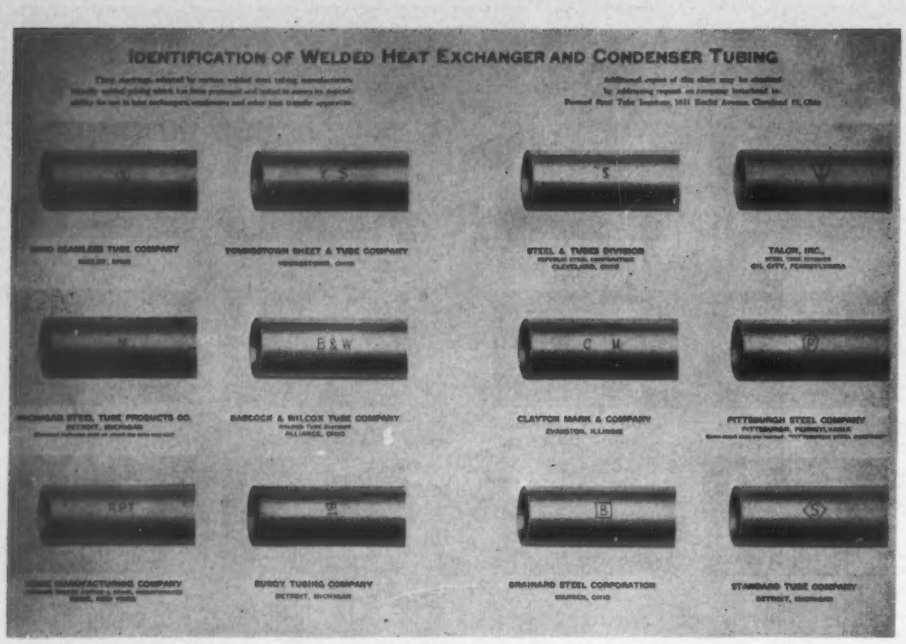
JUIK Processes . . . for Lubricating Oil Refining with Propane and Phenol • Deasphalting • Dewaxing • Solvent Extraction and Acid Treating Plants



In order to avoid the installation in heat transfer apparatus of any welded tubing which has not been specifically manufactured and tested for this application, the welded tubing manufacturers who make tubing for this use consider it advisable to mark each length of welded tubing that is produced for this use with a suitable symbol. Each manufacturer has an individual symbol to use in this way for identification of his product. A chart has been prepared showing the symbols of all companies who manufacture welded steel tubing for heat transfer apparatus and who are reported as having adopted this identification procedure. Copies of this chart are available from the Formed Steel Tube Institute, Cleveland, Ohio.

aviation gasoline and a substitute for rubber became of vital concern to all Americans.

The Big-Inch pipeline was laid and put in operation in record time . . . This booklet in presenting the past of oil and refining and organizations who have served the industry well clearly foreshadows the greater progress and usefulness to come in the post-war era.

MERIT AWARDS

Awards of merit have been made by the government to the following companies:

Ambler plants of Keasbey & Mattison Company, Ambler, Pennsylvania, Army-Navy E for excellence of production.

Esso Laboratories of Standard Oil Development Company of New Jersey, white star to the E flag for second award for continuing to "maintain high standards of production."

The Mathieson Alkali Works, Incorporated, 60 East 42nd Street, New York, New York, white star to the E flag for second award for "high efficiency in production of wartime equipment."

Kerotest Manufacturing Company, Pittsburgh, Pennsylvania, second gold star to Maritime M pennant, for third award indicating "continued outstanding achievement in the production of steel valves for use on the Maritime Commission's cargo vessels and tanker fleet."

Farrel-Birmingham Company, Ansonia, Connecticut, third white star to Army-Navy E.

Ladish Drop Forge Company, Cudahy, Wisconsin, star added to the Army-Navy E flag "in recognition of continued effort and excellence in the production of drop forgings and fittings for military use."

The Wm. Powell Company, Cincinnati, Ohio, a gold star to be added to the Maritime M pennant, for continued meritorious production of wartime equipment.

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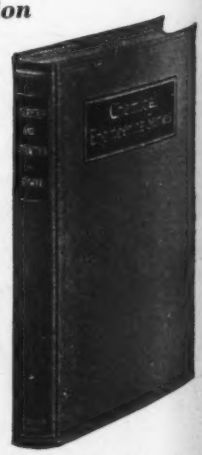

ABSORPTION and EXTRACTION

By THOMAS K. SHERWOOD

Associate Professor of Chemical Engineering, Massachusetts Institute of Technology

278 pages — 91 illustrations — $3.50

This book outlines the underlying theory of such important diffusional processes of the unit operations of chemical engineering as absorption, extraction, drying, humidification, and dehumidification. Particular attention is given to the engineering problems connected with the design and operation of equipment for absorption and extraction.

Special Features:

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—treatment of equilibria in liquid-vapor systems of mixed hydrocarbons.
—method of calculation used in the design of absorbers for natural gasoline and refinery gases.
—outline of the general procedure and treatment of petroleum problems.

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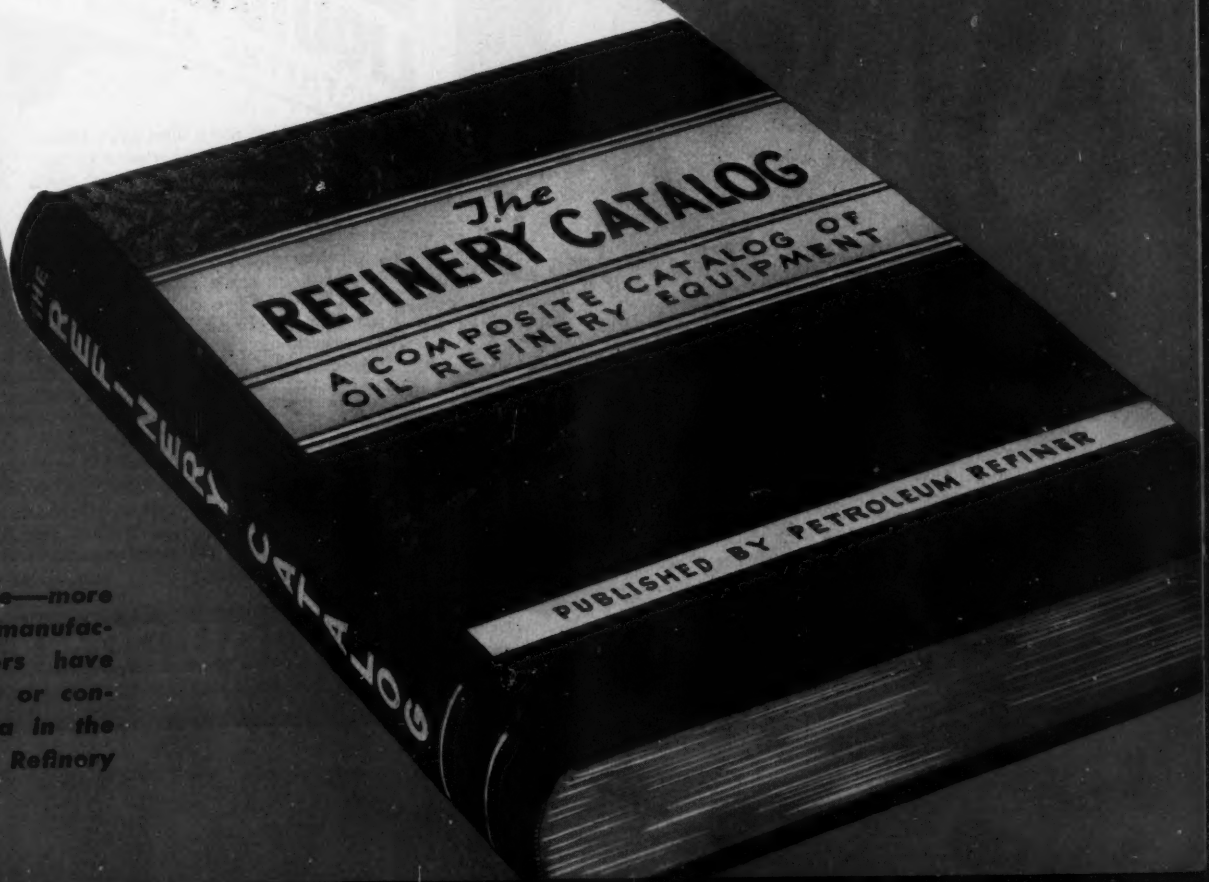

For your convenience—more than 300 leading manufacturers and suppliers have filed their complete or condensed catalog data in the 1943 Edition of The Refinery Catalog.

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Modern refineries are adopting this easy method of handling tank sludge . . . simply mounting a Brooks LOAD LUGGER on a truck chassis and using several detachable one-piece leak-proof buckets for loading, hauling and dumping the sludge to waste pond.

The buckets can be spotted at each outlet, then filled as required, picked up with the LOAD LUGGER for dumping at any convenient time. The driver of the truck operates the Load Lugger hoisting unit from the cab. The Brooks system saves manpower, conserves equipment, and solves a troublesome problem *economically*.

This unit is great for any material which must be loaded into trucks by hand. It increases truck efficiency on many different hauling jobs.

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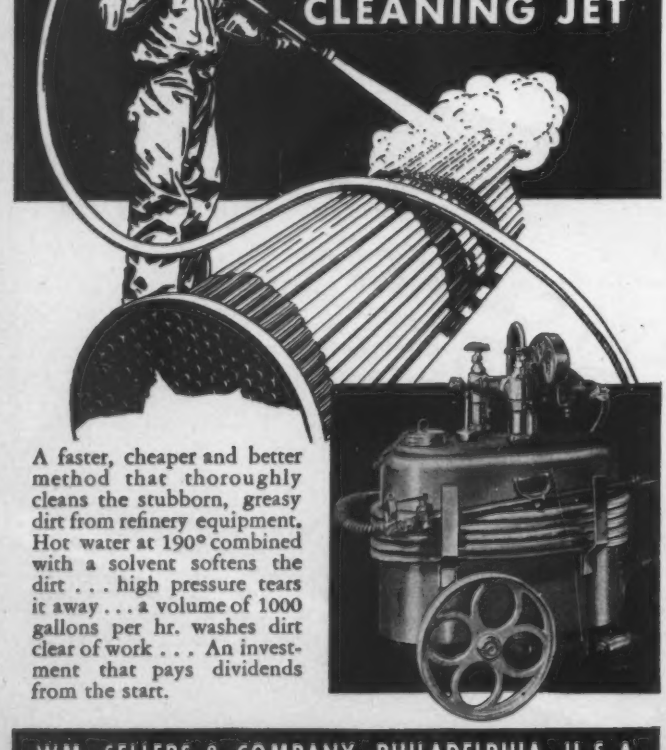

A faster, cheaper and better method that thoroughly cleans the stubborn, greasy dirt from refinery equipment. Hot water at 190° combined with a solvent softens the dirt . . . high pressure tears it away . . . a volume of 1000 gallons per hr. washes dirt clear of work . . . An investment that pays dividends from the start.

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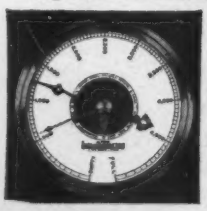

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Mechanical Drive Turbines

Elliott Company, Jeanette, Pennsylvania, has published bulletin H-14, on Elliott mechanical drive turbines with built-in reduction gearing.

To avoid the cost of a separate reduction gear coupled to a turbine for driving machines operating at low speed relative to the best operating speeds of steam turbines, Elliott Company builds mechanical drive turbines with reduction gearing built into and forming an integral part of the drive. The design is suitable for driven machine speeds up to approximately 2000 rpm.

Bulletin H-14 describes the general arrangement of Elliott AY and BY single-stage mechanical drive turbines with these built-in reduction gears, and their space and cost savings over separate reduction gear installations. Pinion, gears, bearings, the lubrication system, the variable speed governor and the turbine itself are described in detail, together with a check-list of outstanding features.

Heat Transmission

Atlas Lumnite Cement Company, 135 East 42nd Street, New York 17, New York, has published a new 16-page booklet, "Heat Transmission Through Furnace Walls," a set of charts on the solution of heat-transfer problems in connection with refractories and high-temperature insulation. Curves on the 10 full-page charts are plotted in terms of conductivity factors. Knowing the conductivity factors of firebrick, insulating brick, refractory concrete, plastic refractories or other refractory material for which the conductivity (K-factor) is known, the designer can select a wall section with optimum heat transfer characteristics to meet the requirements of the installation. Efficiencies of two or more designs of furnace wall or flue lining can be readily compared.

Paint Spraying Chart

Eclipse Air Brush Company, 390 Park Avenue, Newark, New Jersey, has published a wall chart of paint spraying rules showing how to save paint, air, time, power, fuel, and equipment, reduce time lost because of sickness or accident, and improve results. These rules apply to all types of spray equipment.

Paints

American-Marietta Company, 43 E. Ohio Street, Chicago, Illinois, has published a bulletin covering the Valdura line of heavy duty industrial maintenance paints. Fully illustrated, the catalog provides application suggestions, product descriptions and technical data.

Proportioning Equipment

%Proportioneers, Inc.%, 9 Codding Street, Providence 1, Rhode Island, has issued Bulletin No. 1700. In addition to illustrating and describing the complete line of %Proportioneers% constant rate and flow responsive proportioning equipment, the catalog contains many flow diagrams showing latest applications for the process industries. Among the operations described and diagrammed are the treating of water, food products, oils and boiler water; blending ingredients in the production of plastics, synthetic rubber, lubricating oils and aviation gasolines; diluting caustic or other concentrate for rubber reclaiming, sampling of end products and bulk shipments for continuous check.

Centrifugal Pumps

Lombard Governor Company, Ashland, Massachusetts, has issued Catalog P-600, which is restricted to its line of centrifugal pumps. Construction details are given in both illustrations and text. For refinery service the company has especially designed units, which can be supplied in iron, steel, bronze or alloys. Standard sizes range from 3x6 inches to 8x12 inches.

Instruments

Ballou Service & Instrument Company, 76 West Street, New York, has issued Catalog 5, which lists the instruments and services it provides for the refining industry. The catalog is listed as "Balco Products," among which are steel and bronze joints, condensers, heat exchangers, temperature and pressure indicating and recording instruments as well as repairs for these items.

Speed Reducers

Stephens-Adamson Manufacturing Company, Aurora, Illinois, has compiled Catalog 643, which gives information on its line of Saco speed reducers. In addition to details of construction the catalog contains tabular data from which the engineer can determine what model to seek for specific applications.

Potentiometer Controller

Wheelco Instruments Company, Harrison and Peoria Streets, Chicago 7, has issued Bulletin A2-3, describing its line of "Potentiotrols." The 8-page bulletin describes the potentiometer method of heat measurement, and explains the electronic principle employed in the company's instruments to gain instant control in line with the temperatures recorded. Also included is a list of instrument features, four operating diagrams, and a table of potentiotrol scale ranges obtainable with various thermocouples and a photoelectric pickup unit. Copies will be sent on request.

Water Level Indicator

Yarnall-Waring Company, Philadelphia, has published a complete new bulletin on the application and operation of its remote water level indicator. The bulletin is illustrated and contains much detailed description of the indicator along with pictures of actual installations.

Pressure Treated Lumber

Koppers Company, Wood Preserving Division, Pittsburgh, has a new booklet on preserved wood in which there is a section devoted to uses of pressure-treated lumber in oil field construction. Pictured are a number of typical oil field installations, including pipe-racks, derrick foundations, over-water runways, tank substructures, off-shore derricks and storage tanks.

Belt

Manheim Manufacturing & Belting Company, Manheim, Pennsylvania, has ready for distribution, a new catalog on v-belting. The catalog is also an instruction manual and shows in detail the sequence of operations to take "Veelos" adjustable v-belting apart at any point with an ordinary screw driver, and then it shows the necessary steps to couple the belt together again without the use of any tools whatever. Illustrations show the procedure to be used in installing the belt on the drive.

Electronic Tubes

General Electric Company, Schenectady, New York, has issued a 24-page non-technical book titled, "How Electronic Tubes Work." It is designed primarily for industrial engineers. Illustrated with 117 sketches and photographs, the book is a primer whose main emphasis is on how the electronic tube operates. The eight basic types of industrial electronic tubes and their uses are described. The book, GEA-4116, is available free on request to Dept. 6-215, Publicity Divisions.

Book on Pipe and Tube Bending

The Copper & Brass Research Association, 420 Lexington Avenue, New York 17, announces the publication of a new and complete treatise showing methods and devices for bending pipes and tubes of copper and its alloys. This book has been prepared at consumers' requests for authoritative information and contains 80 pages of text with 113 figures and illustrations, including 35 full pages of unit weights of tubes of different alloys with varying diameters, wall thicknesses and shapes, as well as pertinent information on the chemical and physical properties of such pipe material. The text covers such subjects as hot and cold bending, medium radii, temper, the use of mandrels of various types, bending with the use of such filler materials as sand, rosin, salt and low melting temperature alloys.

Electric Trucks

The Yale & Towne Manufacturing Company, Philadelphia, has published a 76-page catalog to acquaint industry with its war-standardized line of electric industrial trucks. The booklet contains detailed descriptions of the models which have been reduced to a few basic types. It also has a number of application illustrations. A separate section is devoted to the workings of the WPB's Limitation Order L-112, as applied to Yale Industrial Trucks.

Electrical Conservation

Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pennsylvania, has published a 96-page booklet on "Wartime Conservation," containing recommendations by Westinghouse engineers for selecting, applying and using electrical equipment so as to achieve the best possible output with the greatest saving in critical materials.

The book covers up-rating of motors, thermal temperature loading of transformers, industrial network systems, line equipment and materials; and gives tips on saving and salvaging materials as practiced in the various Westinghouse plants.

In addition to pointing out ways of saving vital materials in new equipment purchased, the booklet gives many examples of how existing equipment can be made to give better service and greater output by up-rating or rebuilding with more efficient materials than originally used.

Pipe Tools

Beaver Pipe Tools, Warren, Ohio, announces a new 1944 catalog. More complete than previous catalogs, it gives broader coverage to the Beaver line, and dissects Beaver tools and machines for the buyer. A copy of the condensed catalog used by jobbers and jobbers' salesmen is also available.

Pipe Wall Thickness

Midwest Piping & Supply Company, St. Louis 4, Mo., has a new technical bulletin 43-A, "Simplified Method for Calculation of Pipe Wall Thickness." The bulletin has been revised by employing new values for tensile strength, yield point, and the working stress allowable at various temperatures for the different piping materials. Charts present an easy and rapid determination of pipe wall thicknesses at various temperatures based on the Schedule Number Method. It is unnecessary to refer to the Code for Pressure Piping and A.S.T.M. or API specifications, or to substitute in formulae.

Heat Exchangers

The Brown Fintube Company, Elyria, Ohio, has just released a 6-page bulletin, No. 432, describing their newly improved BFT-1 "Sectional Hairpin" Heat Exchangers. The bulletin describes the "non-removable" rear end assembly introduced in these new exchangers, which permits easy and quick entrance into the exchanger for inspection, cleaning, etc., also the easily assembled "Head Seal," and gives dimensions of standard sizes, performance data, and a detailed explanation of other design and structural features of interest to engineers, works managers, superintendents, etc. Copies are available on request.

Recorders

Leeds & Northrup Company, 4934 Stenton Avenue, Philadelphia 44, has prepared Catalog N-96(1), which features "Micromax" recorders designed to measure the pH of a plant process continuously and record it on a chart. This 15-page catalog should be of interest to the oil refinery man in proposing a safeguard

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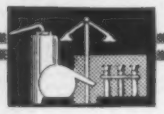

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against production breakdowns and shutdowns for equipment replacement due to the corrosive effects of acids present in fluid catalysts and dehydrator water.

Alloys

The Duraloy Company, Scottdale, Pennsylvania, in an 11-page bulletin, 4328-G, presents further information on chrome-iron and chrome-nickel castings for use where resistance to high temperatures, corrosion and abrasion is necessary. The range of Duraloy alloys and their uses are presented.

Instruments

Taylor Instrument Companies, Rochester, New York, has issued a 24-page bulletin, "The Taylor Guide to Correct Instrument Selection." The catalog is prefaced briefly with a note on the importance of correct instrumentation. There is an outline of the interchangeable feature of Taylor instruments. The bulletin is divided according to the variables to be measured or controlled: temperature, pressure, rate of flow, liquid level, force, position, time cycle, and humidity.

Condenser Tubes

Bridgeport Brass Company, Bridgeport, Connecticut, has compiled a new edition of the Bridgeport Condenser Tube Manual, with over 112 pages documented with photographs, diagrams and 23 tables of up-to-date information. The contents provide much information on copper alloys that should be of great help to engineers and technicians concerned with the selection of tubing for condensers, heat exchangers, evaporators, and general piping in refineries and various process industries. One section is devoted to a detailed discussion of the electro-chemical theory of corrosion digested from technical reports covering extensive tests conducted by Bridgeport over many years.

Mixing and Process Equipment

International Engineering, Inc., Dayton, Ohio, has completed a 30-page booklet on mixing and process equipment designed to offer a sufficient background of general information to guide the user in selecting the type of equipment that should be used for any specific mixing problem. It is also an aid toward forming a preliminary estimate of the rate of work which should be applied to a given batch-volume. Charts, graphs and drawings as well as illustrations, present useful information.

Laboratory Utilities

Precision Scientific Company, 1736 North Springfield Ave., Chicago 47, has ready for distribution a 112-page catalog which gives handy data on laboratory utilities. Petroleum testing apparatus is presented in condensed form in this general bulletin, No. 600, and is treated in more extended form in bulletin No. 700, "Petroleum Products."

ASTM Standards

American Society for Testing Materials, 260 S. Broad Street, Philadelphia 2, has completed ASTM Standards on petroleum products and lubricants.

This pamphlet brings together in convenient form the 1943 Report of Committee D-2 on petroleum products and lubricants, the various ASTM standard and tentative methods of test and specifications pertaining to petroleum, and the regulations and personnel of Committee D-2 and its subcommittees and technical committees.

The society is widely recognized as the authority on methods of testing petroleum and its products and many of the standards contained in this pamphlet have also been approved as standard by the American Standards Association and the American Petroleum Institute.

Simplified Valve Recommendation

A proposed simplified practice recommendation for iron and steel pop safety valves has been submitted to producers, distributors, users, and others interested for approval or comment, according to an announcement by the Division of Simplified Practice, National Bureau of Standards. The proposed recommendation includes iron body, carbon steel body, and alloy steel body pop safety valves, intended primarily for land steam service.

The simplified list will satisfy 95 percent of the requirements for these valves, considering models, inlet sizes, outlet sizes, connections. The variety will be reduced from approximately 3000 to 200.

Mimeographed copies of the proposed simplified practice recommendation may be obtained upon request to the Division of Simplified Practice, National Bureau of Standards, U. S. Department of Commerce, Washington, D. C.

Bending Presses

The Watson-Stillman Company, Roselle, New Jersey, has issued Bulletin 320-A covering its line of straightening and bending presses. Thirty-eight pages of descriptive matter, illustrations and tables of work capacities are augmented by engineering tables and other technical data. Ten of its standard presses, including pipe benders, are treated individually.

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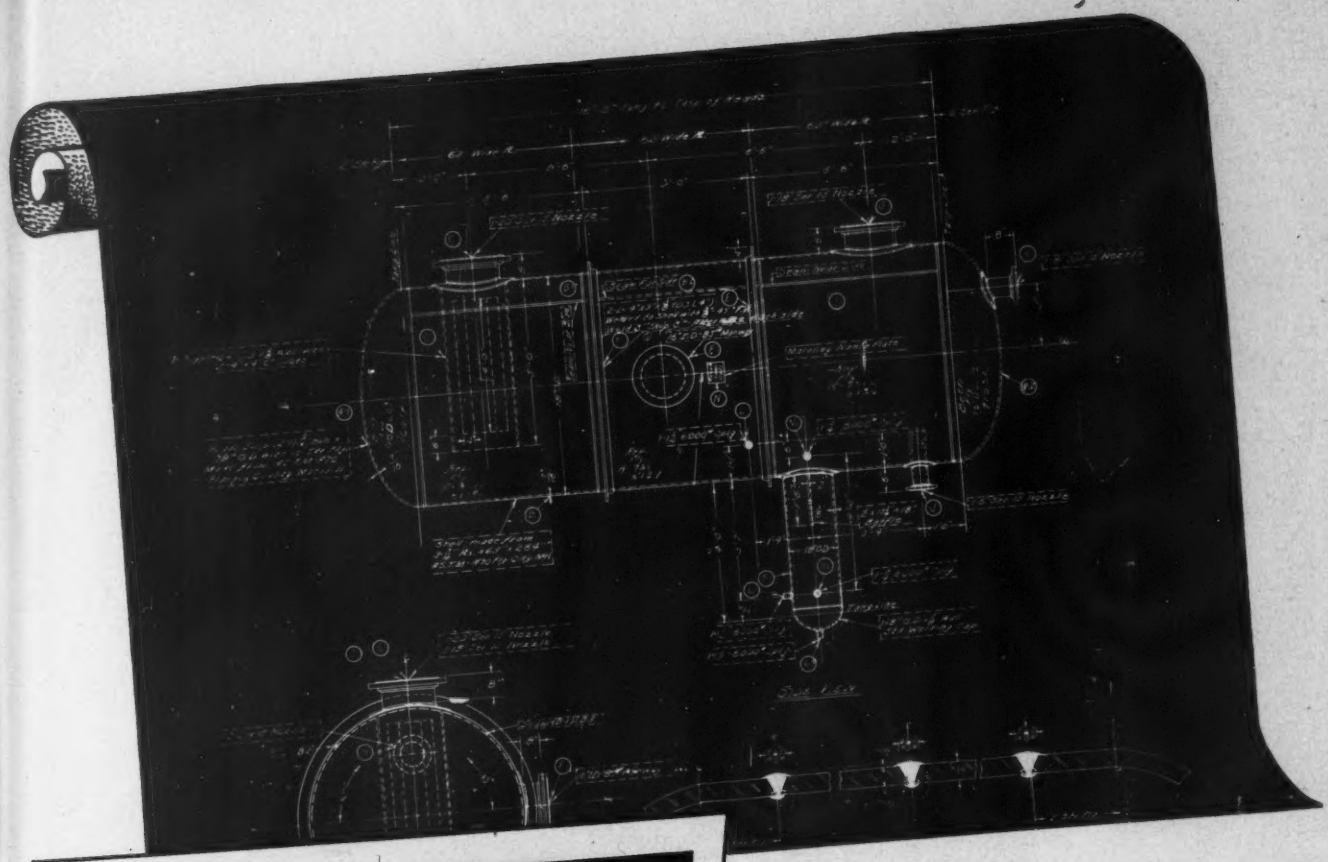

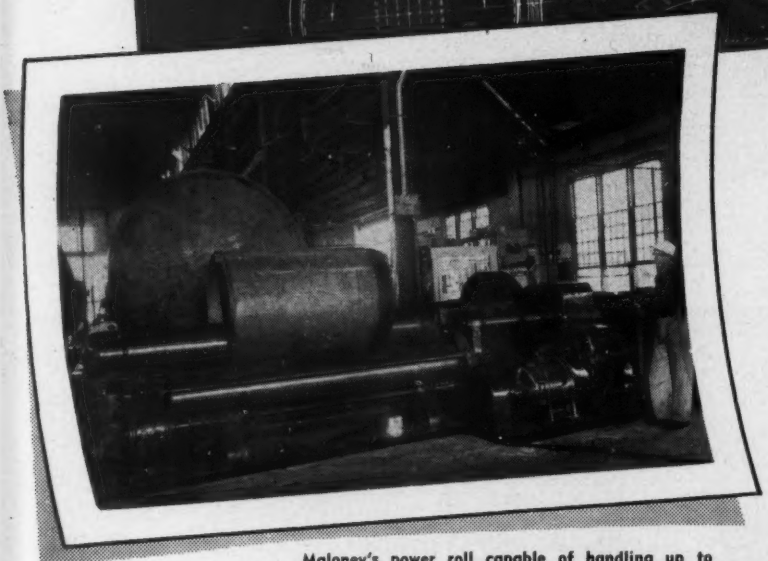

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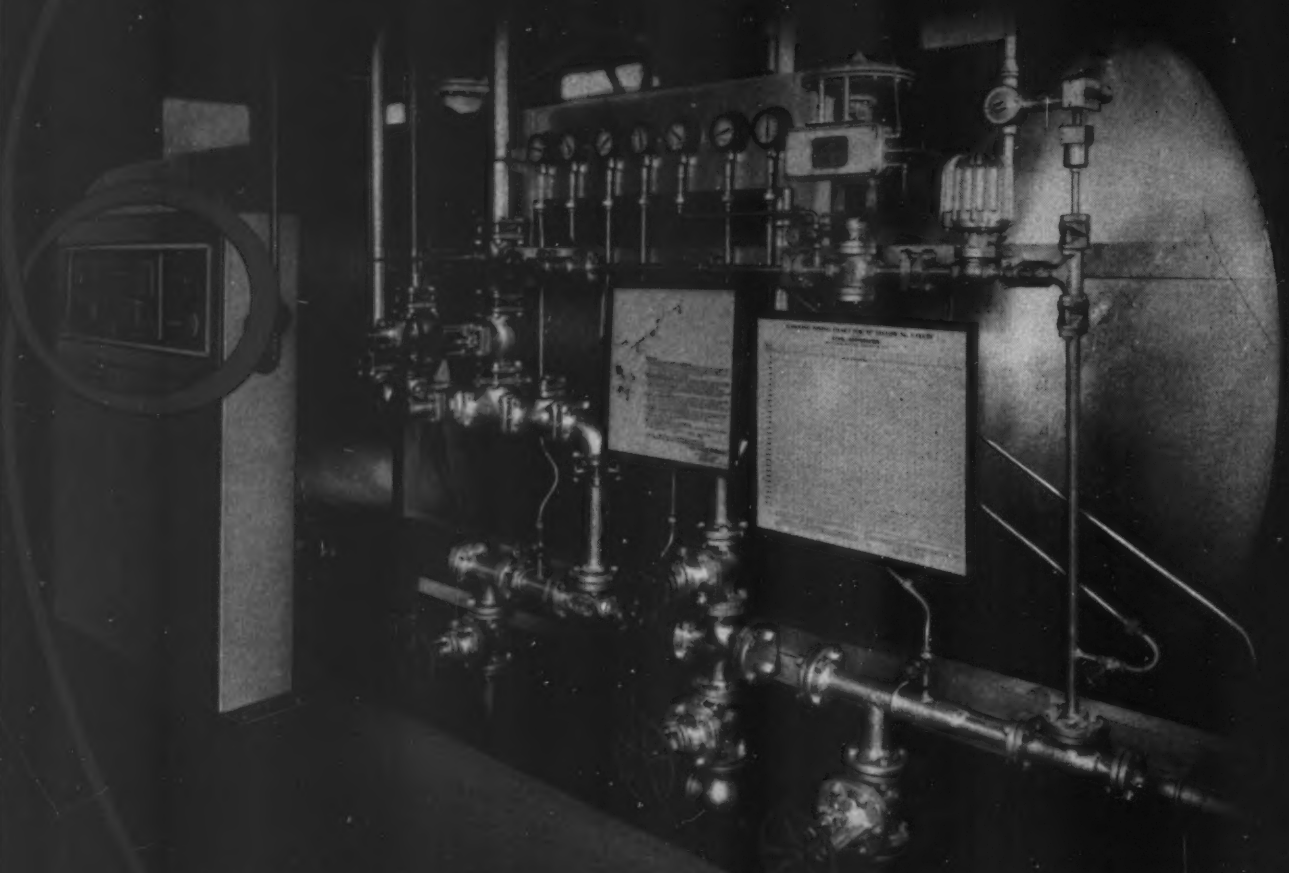

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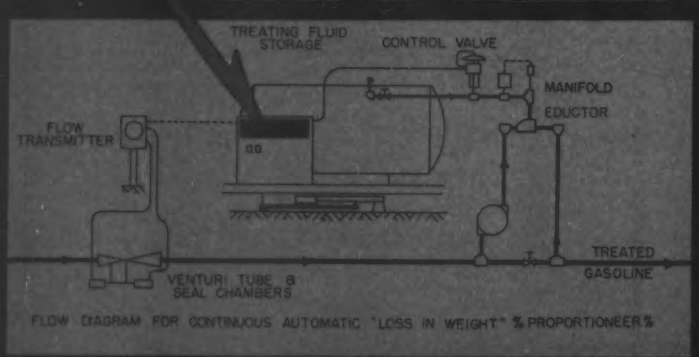

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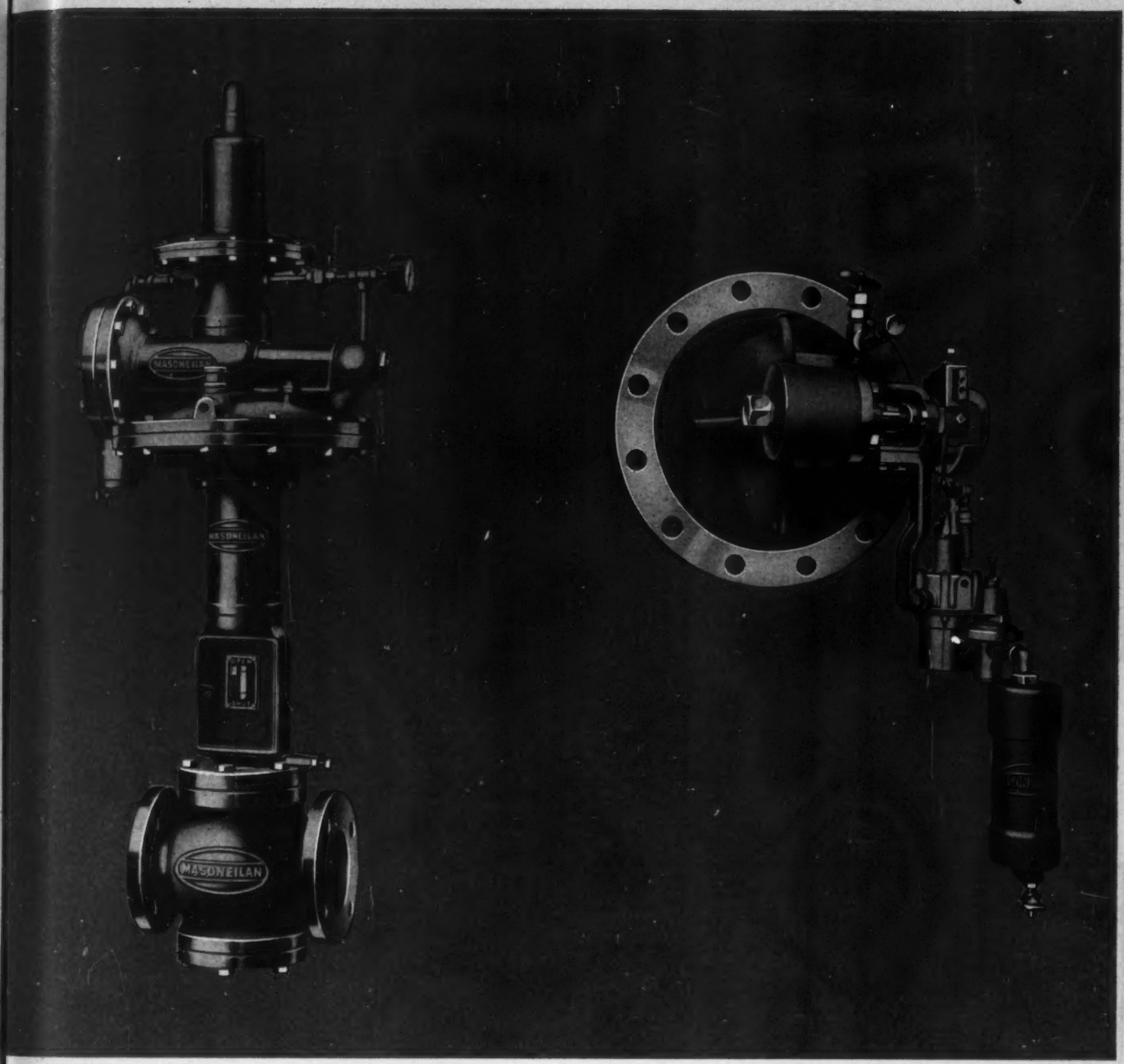

Because automatic controls are so essential to the processing of petro-chemical products and because much of Mason-Neilan capacity has been ear-marked for the manufacture of control equipment for emergency plants, some of our friends may have been unable to get such equipment when they wanted it. We know you realize that vital war-winning projects come first and we thank you for your patience . . . You can help by planning your requirements as far ahead as possible. We in turn will make every effort to meet desired shipping dates.

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Boston, Massachusetts

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IV.	Structural Stability	Carbide Precipitation Spheroidization Temper Embrittlement
V.	Stability at Operating Temperature	Retention of Ductility Retention of Shock Resistance
VI.	Retention of Original Room Temperature Properties after Service	Ductility Impact Hardness Microstructures

Basic Requirements for High Temperature Service

The conditions under which high temperature steels operate may vary considerably, but there are certain basic requirements they must have to give satisfactory service.

High temperature steels, (especially those of the brittle type), must all have satisfactory room temperature physical properties to permit their installation, and must retain these properties after a long exposure to stress in order to prevent failures.

The emphasis to be placed on high temperature load carrying ability and surface stability varies, depending on the proposed operating conditions, but these factors are so closely related that one cannot be considered without the other.

Additional information on this subject is available upon request. Steel & Tube Division, The Timken Roller Bearing Company, Canton, Ohio.

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2. Bypass valves not needed with Armstrong Traps. A bypass valve left open accidentally or on purpose will shrink boiler capacity a lot.
3. By keeping air out of steam heated process equipment, work can be done in a shorter time, thereby reducing non-productive radiation losses.

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1. It prevents accumulation of dirt which would interfere with trap operation.
2. Dirt will not lodge between valve and seat to prevent tight closing of the trap valve.

For more than thirty years, the Armstrong Machine Works has specialized on making inverted steam traps and Armstrong Representatives have specialized on mastering trap selection and installation problems. Call on this combination to handle your trapping problems. Write today for Catalog.

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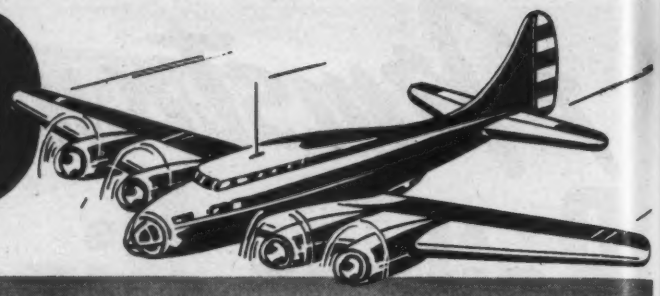

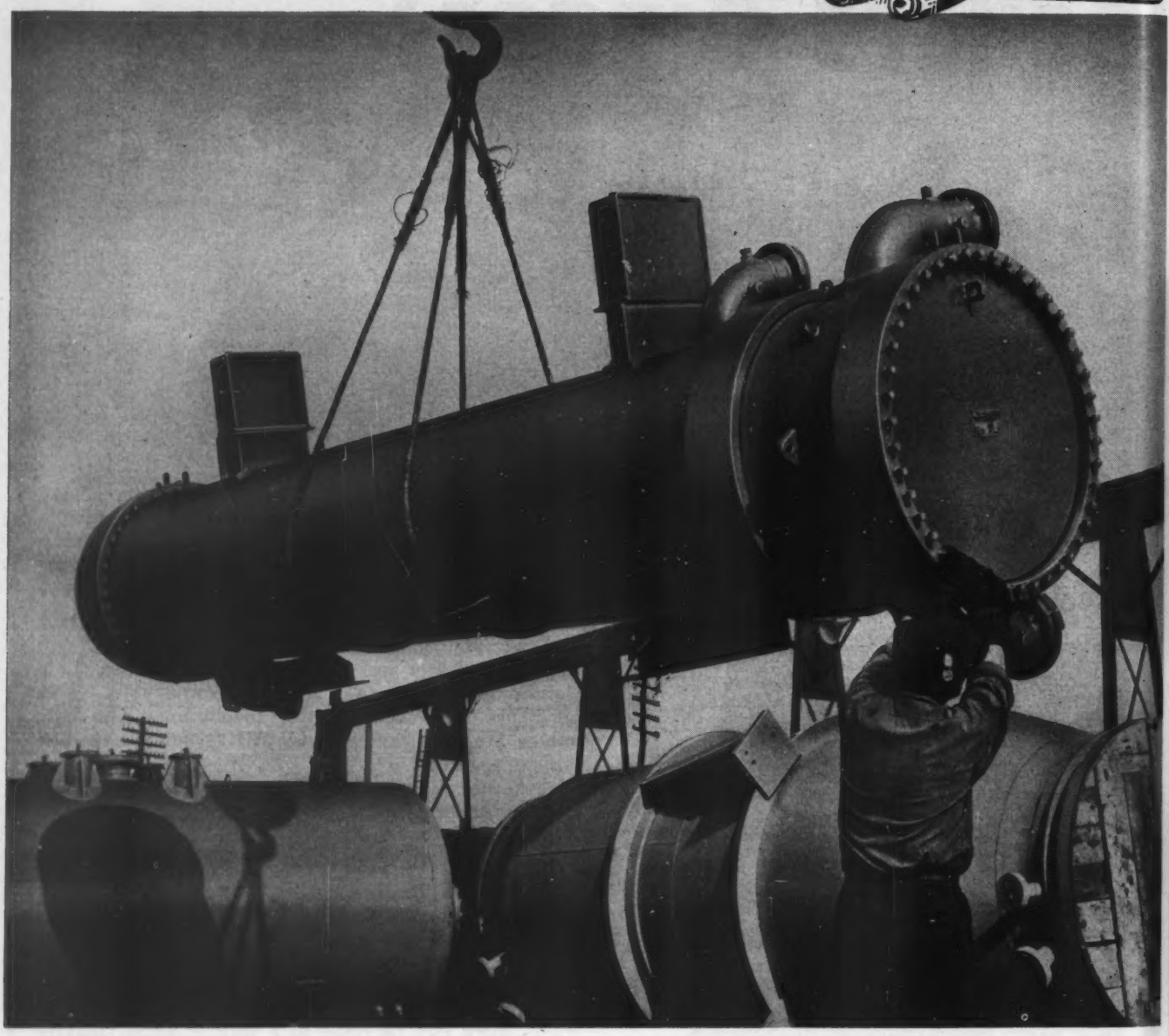

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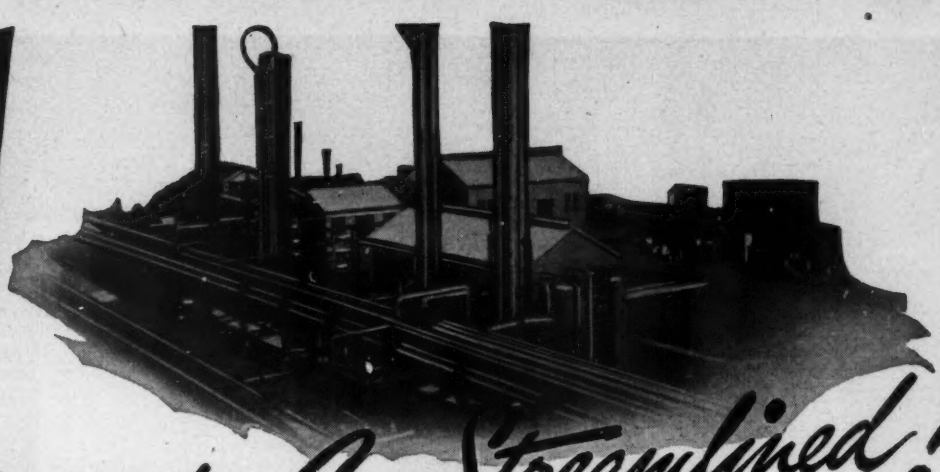

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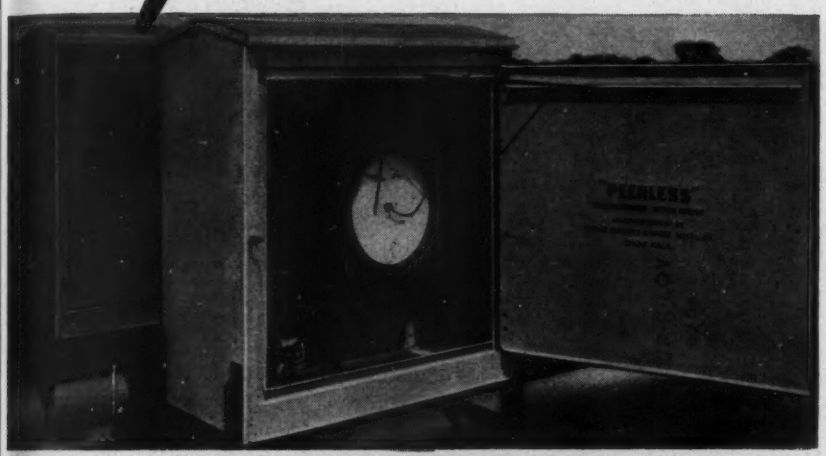

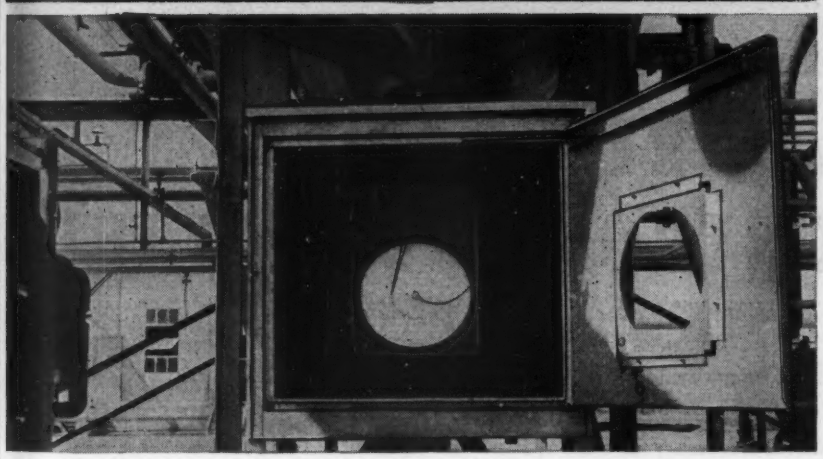

PLANT SIMPLIFICATION is in order . . . stipulated for new construction or remodeling. This stripping of "non-essentials" applies to equipment as well.

New emphasis therefore is placed on the more practical scientific applications of measurement and control instruments. Their duties are enlarged. Their selection must be scrutinized with greatest care, since replacements to cover "mistakes" may be difficult.

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Metric-American orifice meters at a simplified new gasoline plant where equipment and controls are kept at a minimum. The finished liquid product is piped to a refinery at which high-octane aviation motor fuel is made, while the residue gas is sold to a utility which manufactures electric current for war plants.

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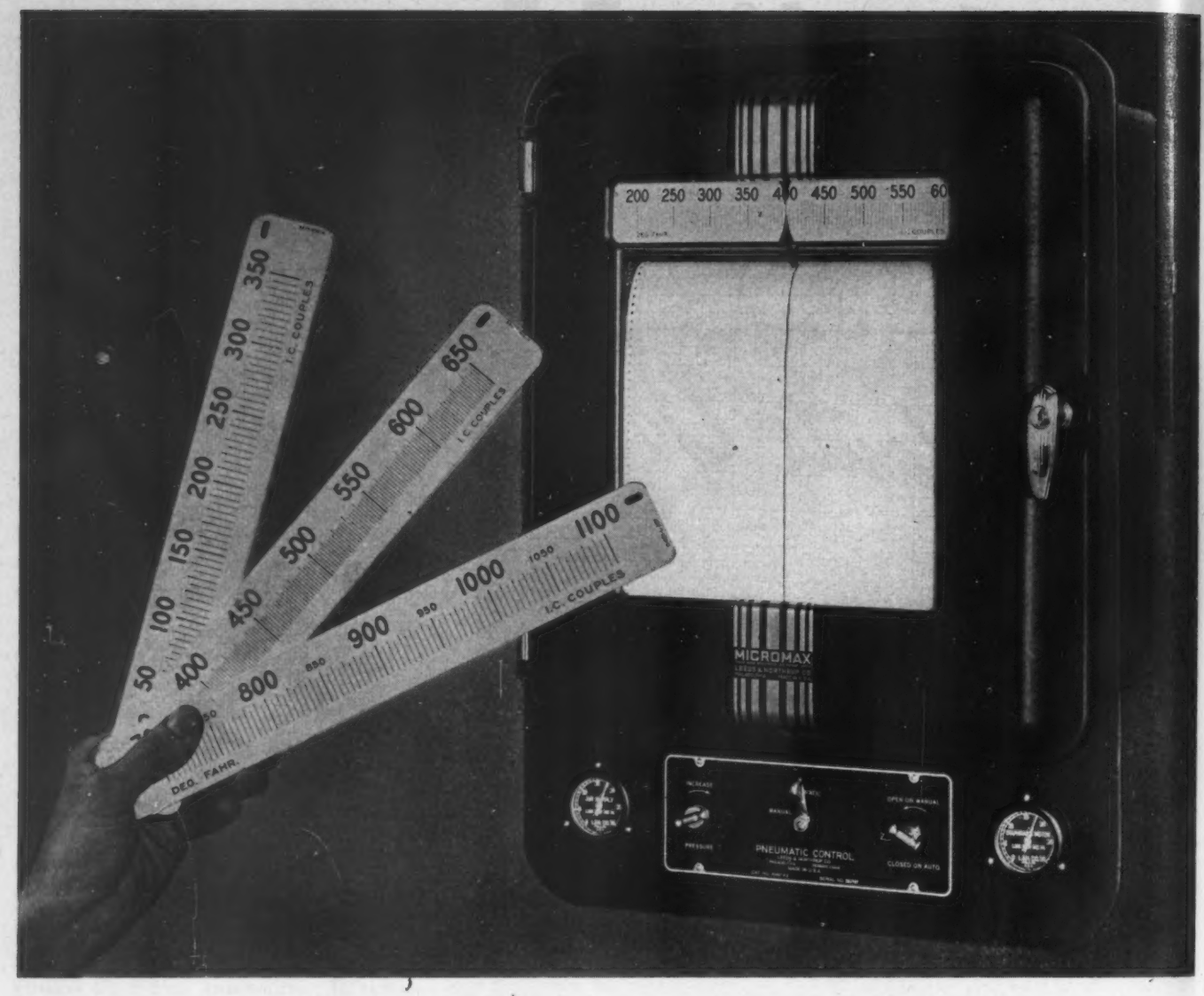

HIGH TEMPERATURE OR LOW— MICROMAX CONTROLS DEPENDABLY

Every potentiometer controller needs an occasional "standardizing" to maintain its electric circuit at correct voltage. Neither range nor application can eliminate this need; no matter how busy a worker may be, when time comes to standardize the pyrometer, that instrument can't be accurate until it gets attention.

And that's why Micromax standardizes itself, at least every 45 minutes. This is much oftener than a man would standardize the Controller; much oftener than is necessary if the instrument's operating cells are at their best level of performance. But very new cells, or very old ones, or ones which have been frozen, baked or otherwise damaged, have no sustained level. So, here as always, Micromax takes no chances. It standardizes so frequently that the Controller is always ready for the most accurate service required in any refining operation.

For a general description of Micromax Pneumatic Controllers, see Catalog N-00B. For specific engineering data, outline your problem.

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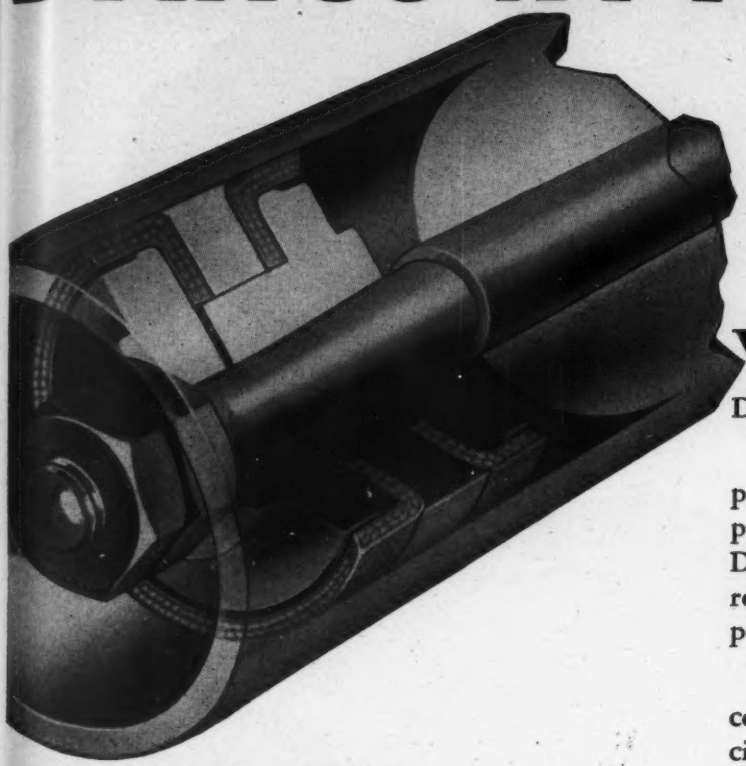
DARCOVA PUMCUPS



Unique principle saves up to $100 every year for thousands of pump users

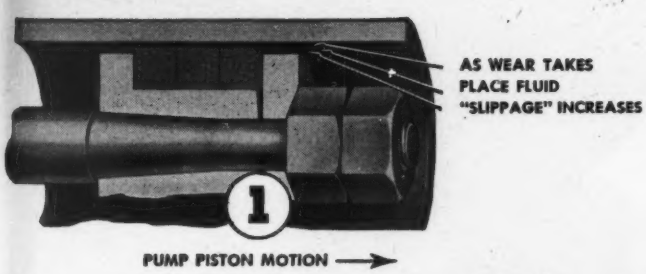
WHATEVER you pump—water, oil, gas, steam, alkalies, acids, or other liquids—Darcova can save you time and save you money.

Darcova is the original composition valve cup, proved by 35 years of service. As applied to pumps, it is known as the Darcova Pumcup. Darcova Pumcups are readily applied to any reciprocating pump by means of a simple, inexpensive adapter piston, illustrated above.

By employing the simple cup principle, Darcova increases pump capacity and pumping efficiency. On the pumping stroke, fluid pressure against the inside of the cup forces the sidewall out against the liner, creating a tight seal that prevents slippage past the piston. This tight seal also prevents lodgment of dirt or abrasive particles between cup and liner, and so reduces scoring and wear.

Just compare this efficient action with that of ordinary pump packing. And remember, too, that Darcova's unique composition stands up—not only against the frictional wear of millions of pump strokes, but against chemical action of all kinds, too.

No wonder thousands of Darcova customers are experiencing up to $100 saving per pump per year.

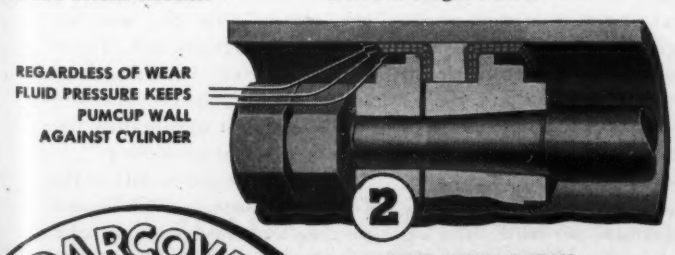


1 THE OLD WAY

From the minute ordinary packing is installed in your pumps, it begins to wear. Each piston stroke means increased clearance between packing and liner. Added clearance means more slippage—and more loss of efficiency—until finally efficiency drops so low that the pump must be repacked. Note also that friction load is the same on both load and return strokes.

2 THE DARCOVA WAY

With Darcova Pumcups, the cup principle insures constant pumping efficiency. Fluid pressure keeps the Pumcup sidewall in close contact with the liner, regardless of wear. There is minimum slippage. Furthermore, on change of stroke, pressure inside the Pumcup is released and load on return stroke reduced. This means fewer shutdowns and many hours of longer service.



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DARCOVA
THE ORIGINAL COMPOSITION CUP

DARLING VALVE & MANUFACTURING CO.
WILLIAMSPORT, PA.

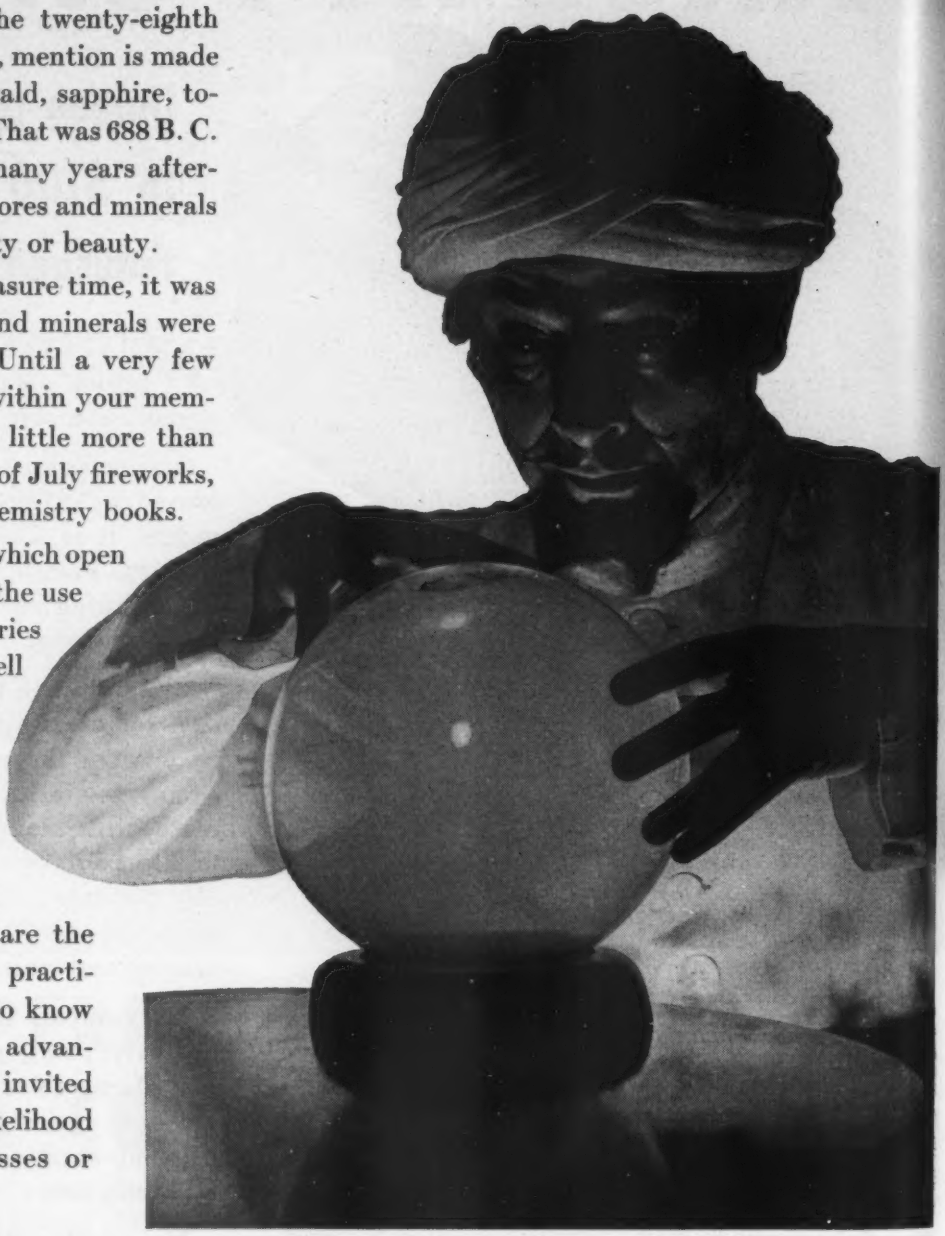
Wanted: More Crystal-Gazers

In the thirteenth verse of the twenty-eighth chapter of the Book of Ezekiel, mention is made of diamond, beryl, onyx, emerald, sapphire, topaz and other precious stones. That was 688 B. C. For many years before and many years afterward, the world's crystals and ores and minerals were prized only for their rarity or beauty.

In fact, as mineralogists measure time, it was scarcely yesterday that ores and minerals were discovered to be of real use. Until a very few years ago, for example—well within your memory—abundant strontium was little more than a red glow reserved for Fourth of July fireworks, lithium an obscure name in chemistry books.

Today, there are discoveries which open greater and wider horizons for the use of ores and minerals; discoveries which affect your industry as well as scores of others. Foote, by reason of long experience and extensive research into ores and minerals and chemicals, is in the forefront of these developments.

You who in your industry are the "crystal-gazers" of the most practical kind, you whose job it is to know what new thing can be used advantageously in your products, are invited to write us. There is good likelihood that Foote products, processes or research can benefit you.



SOMETHING NEW IN GREASES TO WORRY THE AXIS

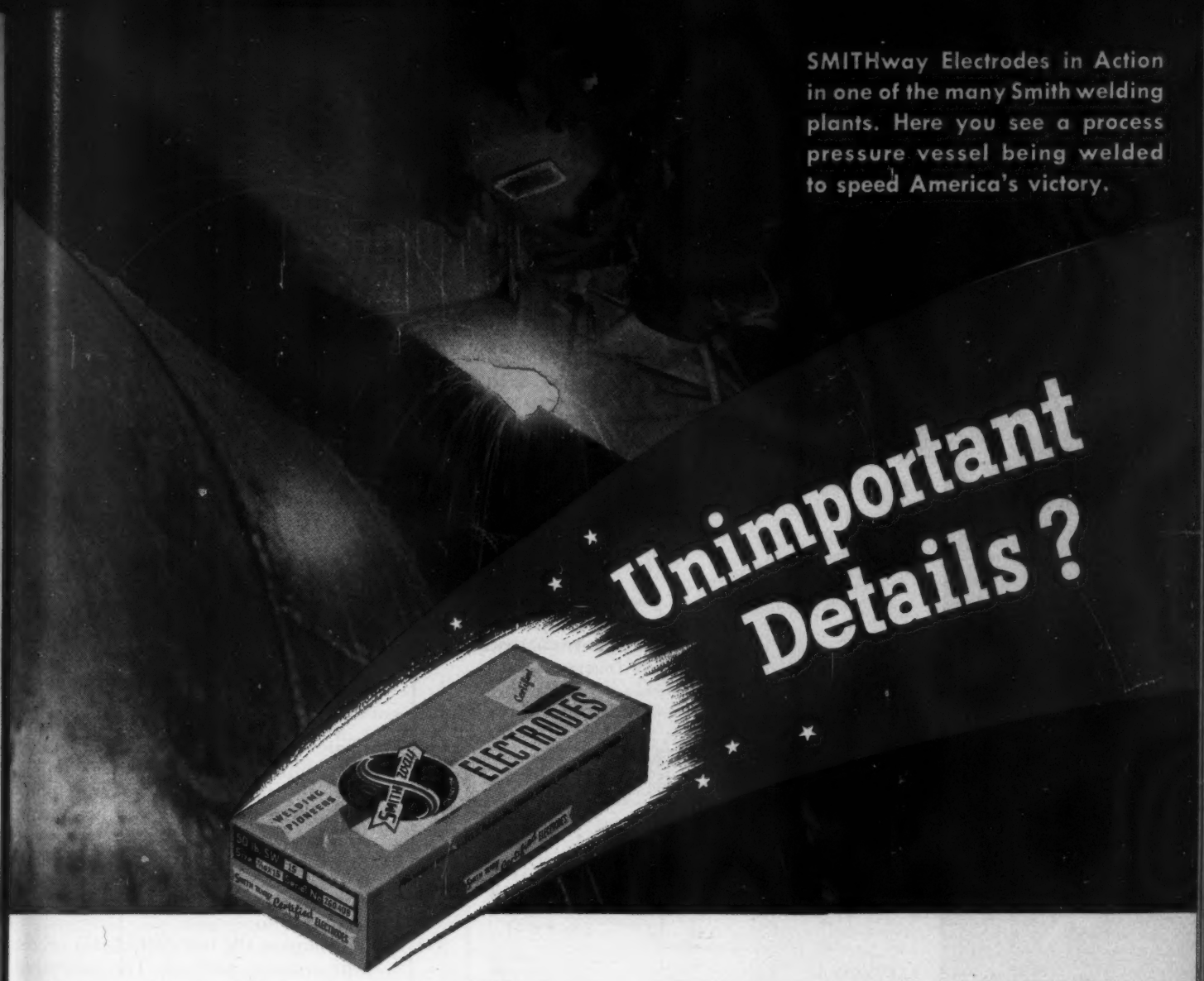
Hermann Göring and his cronies can take small comfort from the performance of greases made with Litholite "A", (Foote Lithium Stearate). For these new greases have the remarkable ability to function with consummate ease in temperatures ranging from 400°F. down to sub-polar, stratosphere temperatures of −90°F. The advantages of such greases in the mobility of planes, tanks and other war weapons can readily be imagined. But the possibilities of these all-temperature, all-weather lithium greases after the war can scarcely be prophesied. These greases are easy to make, form stable jells, and require neither precautions against over-heating nor close control over cooling.

The only licencee to date is the Gulf Oil Corporation. Other licenses pending. You are urged to write for complete information in connection with a license for the manufacture of greases using Litholite "A" under U. S. Patent Number 22299.

Foote
MINERAL COMPANY

A Step Ahead in Industrial Ores and Chemicals

PHILADELPHIA • ASBESTOS • EXTON, PENNSYLVANIA
Home Office: 1615 SUMMER STREET, PHILADELPHIA, PA.
West Coast Representative: GRIFFIN CHEMICAL CO., San Francisco, California
English Representative: ERNEST B. WESTMAN, LTD., London, England


SMITHway Electrodes in Action in one of the many Smith welding plants. Here you see a process pressure vessel being welded to speed America's victory.
Unimportant Details?
ELECTRODES
WELDING PIONEERS

There ARE NONE in the manufacture of SMITHway Welding Electrodes!

Why can't we slight even the smallest detail in the manufacture of SMITHway Certified Welding Electrodes? Here's why! It is an everyday occurrence for men in our plants to weld vessels that must withstand working pressures up to 5000 psi!

When welding electrodes must shoulder their share of *that* kind of responsibility, only the best are good enough! That is why we make our own.

If all who make welding electrodes used the electrodes they make, as we do, they would know why our rule book says—"There *are no* unimportant details in the manufacture of SMITHway Certified Welding Electrodes."

That is the kind of dependability we offer you in SMITHway Electrodes. And they can give you what they give us—*better welding results* at lower time and material cost. That can be proved in *your* shops.

Mild Steel . . . High Tensile . . . and Stainless Steel

WELDING ELECTRODES

made by welders . . . for welders

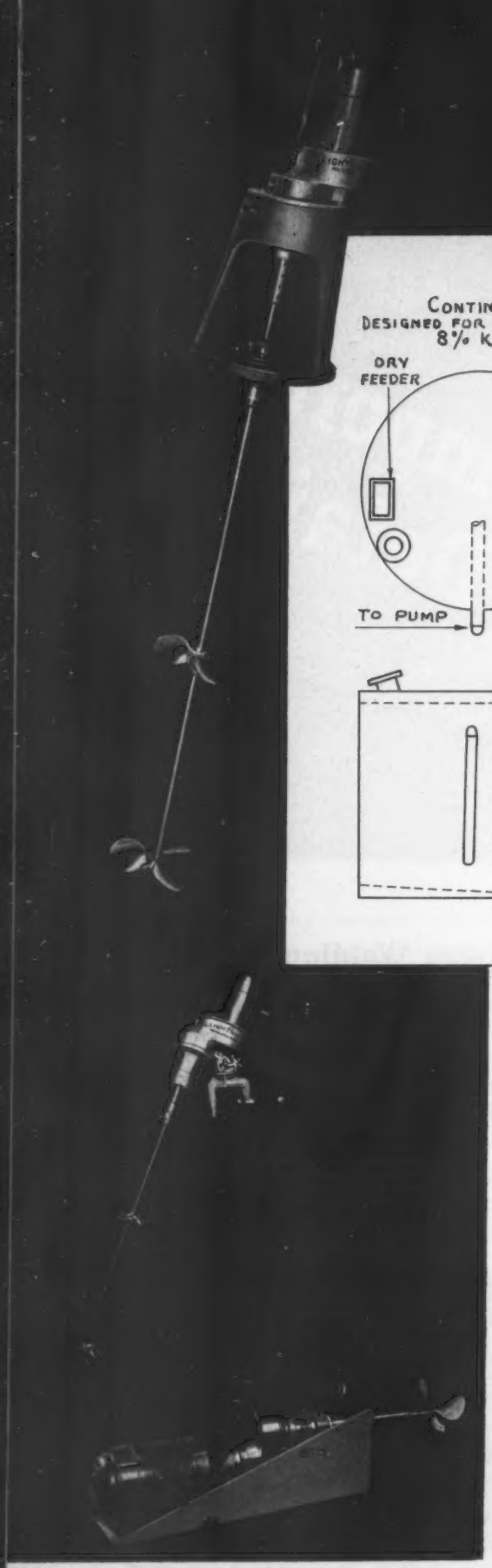
SMITHway Welding Monitor
cuts training time as much as 33⅓%.

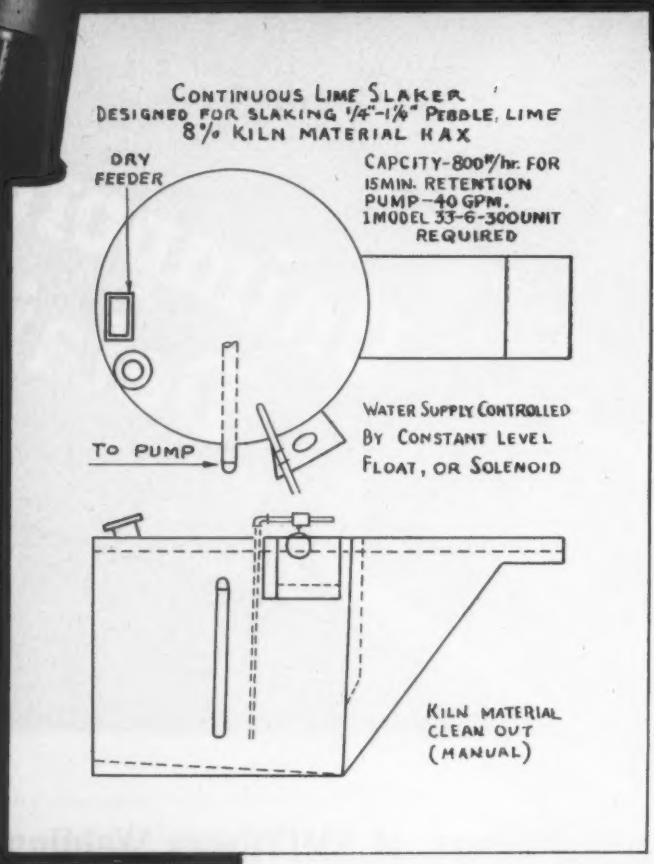
SMITHway AC Welding Machine
reduces spatter losses; eliminates arc blow.

SMITHway

A.O. SMITH *Corporation*

MILWAUKEE • WISCONSIN ★ HOUSTON • TEXAS




CONTINUOUS LIME SLAKER
DESIGNED FOR SLAKING 1/4"-1 1/4" PEBBLE, LIME
8% KILN MATERIAL MAX
DRY FEEDER
CAPCITY-800#/hr. FOR 15MIN. RETENTION
PUMP-40 GPM.
1MODEL 33-6-300UNIT REQUIRED
WATER SUPPLY CONTROLLED BY CONSTANT LEVEL FLOAT, OR SOLENOID
TO PUMP
KILN MATERIAL CLEAN OUT (MANUAL)

An application which includes the suspension of filter aid, Fuller's earth, activated carbon, and crystals, while dissolving. Also efficient in the slaking of lime, preparation and storage of milk of lime, and all slurries.

Here's an Example

To provide a continuous flow of milk of lime at 20% concentration, the usual procedure would be to supply a lime slacker, move product to a preparation tank, and then to storage—all by batch process.

Today this can be combined into a single vessel equipped with a dry feeder, interconnected with a pump and liquid level control and—if desired—to hydrogen ion control. When the demand is supplied, the dry feeder stops, the water valve is shut off and the pump ceases to operate. The mixer continues to operate, however, to maintain material in proper suspension.

Compare the low cost of this process with ordinary methods. The horsepower of the mixer is selected to give the desired suspension of kiln material—(1) to collect all of it in the tank, or (2) to permit the larger particles to collect in the tank, or (3) to pass all kiln material out of the tank.

Pebble lime can be used with this process.

The tank must be large enough to provide residence time slightly greater than the slacking period. The retention or the passing on of kiln material shows how solids can be graded by the action of a properly selected agitator.

In suspending solids to produce a chemical or physical change, proper agitation insures the dispersion and minute separation of each individual particle, and presents each particle's entire surface area to the liquid phase. For this reason when using Fuller's Earth for bleaching or activated carbon for decolorizing, a vessel with good agitation uses less activated material and less time to achieve results. Important savings are being made in decoloring syrups, glycerine, animal and vegetable fats and oils.

Agitation which is exactly adapted to a given operation by process engineers will save material and time—insure a better product at lower cost—than the methods you are now using. There is no need for a new installation. "*LIGHTNIN*" Mixers are available for your present tanks.

Watch these Mechanical Details

When agitation is applied for a definite objective or function, the mechanical engineering details are supremely important. This is especially true in handling solids in suspension, for most solids are abrasive to a greater or lesser degree. The right metals must be chosen to prevent mechanical erosion. Step bearings should be avoided by all possible means. Coils should

LIGHTNIN AND MIXCO AGITATOR

...s Adapted

not be used unless absolutely necessary. Pancake coils must never be employed. Helical coils should be widely spaced and supported approximately three times their diameter away from the side walls. Flat bottoms and sharp corners must be avoided—square or rectangular vessels are *out*. Desirable tank proportions:—Depth of liquid not less than diameter of tank.

For batch operations, tank should seldom be completely emptied as uniformity of suspension will be difficult to maintain in last few feet. Process should be arranged to carry a "heel," i.e., a minimum liquid level.

The Basis of our Recommendations

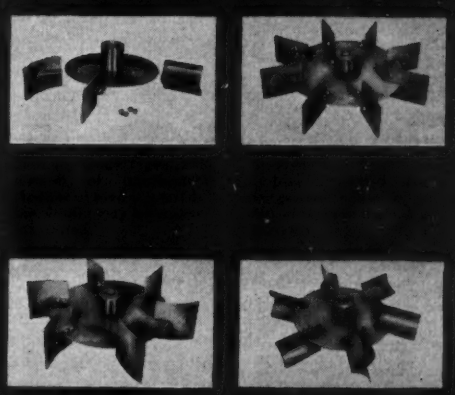
Twenty-three years of experience has resulted in an organization, research facilities and skill which qualify Mixing Equipment Company as an authority in the field of agitation.

Mixing Equipment Company offers its services in the solution of any problem involving controlled recirculation of liquids to produce physical and chemical changes, as included in the following table.

Blending Miscible Liquids	Mixing Immiscible Liquids	Crystal Size Control	Gas Absorption & Dispersion	Suspension of Solids	Heat Transfer
Simple Mixing of soluble liquids as in reducing concentration.	Washing of Liquids Extraction Contacting Caustic Treating Emulsions	Precipitation Evaporation Systems	Hydrogenation Aeration Gas Scrubbing Chlorination Gas Washing	Slurries Slaking Lime Suspension of: filter aid, activated carbon, Fullers Earth, Crystals while dissolving.	Stills Evaporators Reactor Vessels Heating Cooling

There is a process adapted agitator for every size and shape of tank and every operation; for batch or continuous operation. Your savings will quickly repay the necessary modest investment.

Because Mixing Equipment Co. products include *all* types of fluid agitators, you can obtain from them an impartial recommendation for the most economical solution of any fluid agitation problem. Engineers will gladly assist you in solving your particular agitation problem.



What Size and Type do you need?

There is one size and model of mixer which will best answer the requirements of each individual mixing job. "*LIGHTNIN*" and MIXCO Mixers and Agitators are available in sizes ranging from 1/40th H.P. laboratory models to 50 H.P. agitators. Each size and model has a wide range of applications, but each also has definite limitations.

Perhaps you need a turbine type instead of propeller. If that is the case, Mixing Equipment Company have available a variety of turbines to meet every agitation requirement.

LIGHTNIN
TRADE MARK REG. U.S. PAT. OFF.
MIXCO

There is a process adapted agitator for every size and shape of tank; for batch or continuous operation. Your savings will quickly repay the necessary modest investment. Because Mixing Equipment Co. products include *all* types of fluid agitators, you can obtain from them an impartial recommendation for the most economical solution of any problem involving fluid agitation. Mixing Equipment Company engineers will gladly assist.

MIXING EQUIPMENT CO., INC.
1064 GARSON AVENUE • ROCHESTER 9, N. Y.

MIXING EQUIPMENT CO., INC.
1064 Garson Avenue, Rochester 9, N. Y.
Please send me the literature checked:

- ☐ B-76—Side Entering Mixers
- ☐ B-78—Top Entering Mixers
- ☐ B-75—Portable Mixers
- ☐ B-69—Air Driven Mixers
- ☐ B-77—Laboratory Mixers
- ☐ Mi-11—Operating Data Sheet

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Company.....
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SCRAM-YOU SISSIES!

Abrasion and wear know when they're licked. That's because the hard, long wearing surface deposited by Harcote guards against these saboteurs. Protecting softer steels from abrasion and wear is Harcote's way of keeping vital machines producing for Victory.

But beneath all this hard surface, Harcote is really a softie in the hands of a welding operator. Easy to work — goes on smoothly and places a weld that's tough and hard. Harcote is used on carbon steel, low alloy and high manganese surfaces. See your P&H representative for information and procedures on this and other P&H Alloy Electrodes, or write us.

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P&H Also Builds a Complete Line of A.C. and D.C. Arc Welders. Write for Literature.

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ARMY E NAVY

Another New Star has been Added to P&H's Army-Navy "E."

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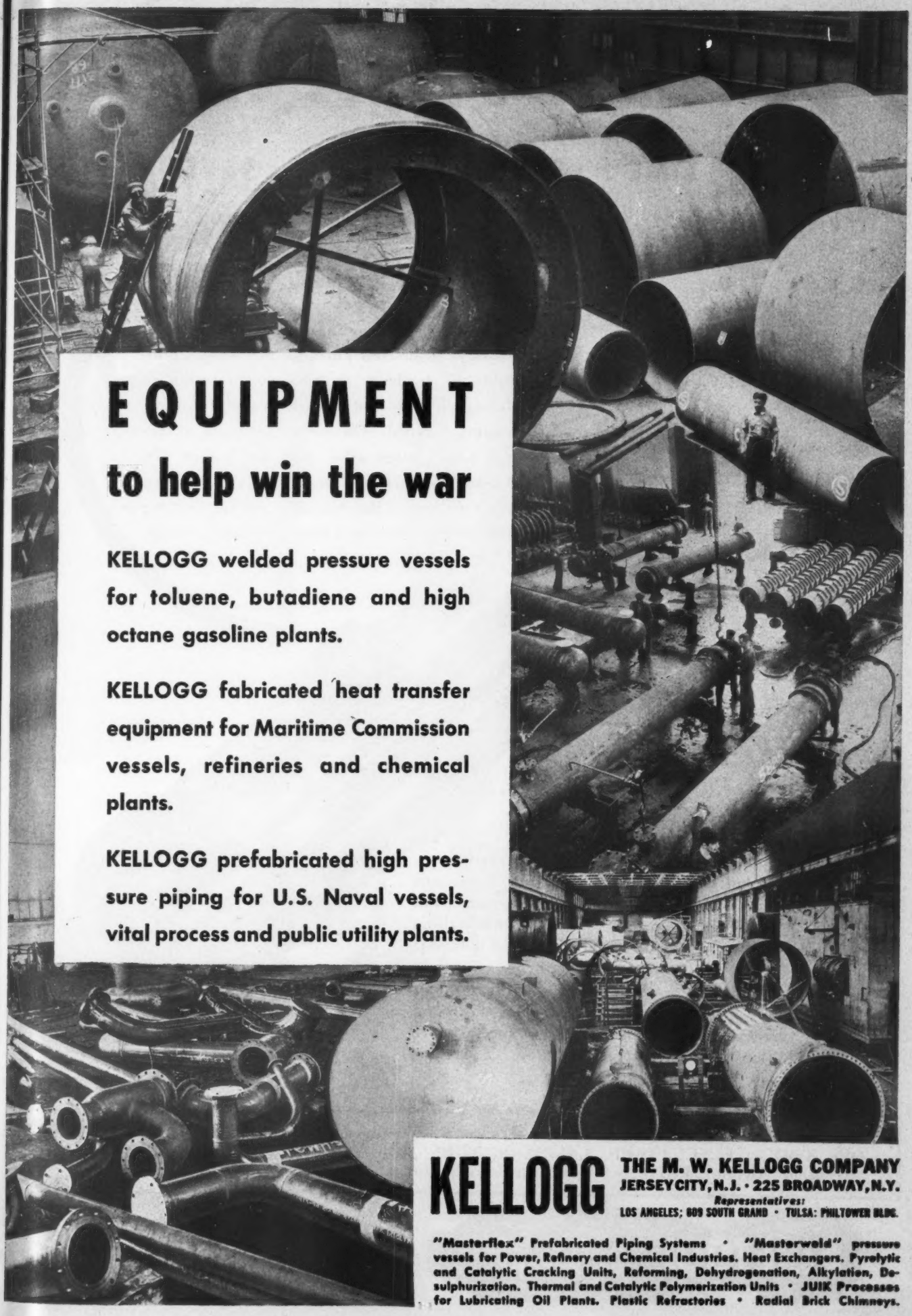
WELDING ELECTRODES • MOTORS • HOISTS P&H ELECTRIC CRANES • ARC WELDERS • EXCAVATORS

Canadian Distribution: The Canadian Fairbanks-Morse Company, Ltd.



EQUIPMENT
to help win the war

KELLOGG welded pressure vessels for toluene, butadiene and high octane gasoline plants.

KELLOGG fabricated heat transfer equipment for Maritime Commission vessels, refineries and chemical plants.

KELLOGG prefabricated high pressure piping for U.S. Naval vessels, vital process and public utility plants.

KELLOGG

THE M. W. KELLOGG COMPANY
JERSEY CITY, N.J. · 225 BROADWAY, N.Y.
Representatives:
LOS ANGELES; 609 SOUTH GRAND · TULSA: PHILTOWER BLDG.

"Masterflex" Prefabricated Piping Systems · "Masterweld" pressure vessels for Power, Refinery and Chemical Industries. Heat Exchangers. Pyrolytic and Catalytic Cracking Units, Reforming, Dehydrogenation, Alkylation, Desulphurization. Thermal and Catalytic Polymerization Units · JUIK Processes for Lubricating Oil Plants. Plastic Refractories · Radial Brick Chimneys.

Airetool TUBE CLEANERS

SAVES TIME . . SAVES LABOR . . SAVES TUBES

HERE'S WHY . . .

One of the outstanding features of Airetool Cleaners is the New Form Cutters which eliminates the tendency to *track* which results in damage to tubes and necessary expensive, time-wasting removal. The cutters are made of special heat treated alloy steel for longer life. Airetool Cleaners are for ½" to 24" I.D. tubes, also for Catalyst Reactor units and for cleaning between the tubes in a heat exchanger bundle.

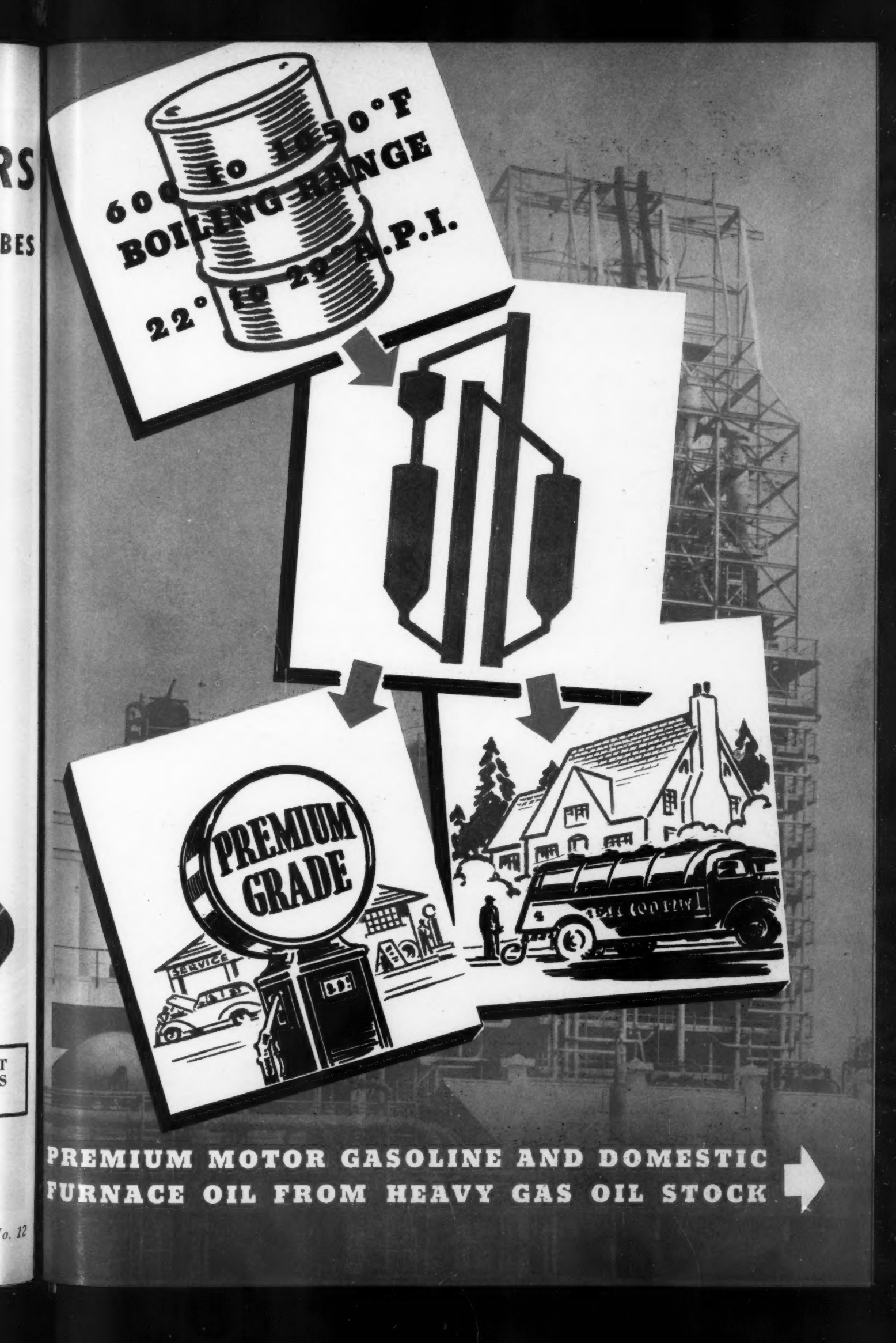
and HERE'S WHY . . .

Another feature is the unique Airetool Motor—cut-away view right—which developes 28% more power and has many advantages . . . constant torque at low speeds; no dead centers; can be loaded down to 50 r.p.m. without stalling and, as soon as the load is released will start immediately. The motor is made of special wear-resistant alloy steel. Its slip-fit construction permits the motor to be taken down and reassembled on the job without special tools. *Save time, save labor, save tubes . . . investigate Airetool Cleaners.*

TUBE EXPANDERS in a variety of sizes to meet every need, COMBINATION BORING AND CUT OFF TOOLS, FLYCUTTERS, CALIPERS, TUBE JIGS, POLISHING and BUFFING MOTORS are other Airetool Products. Write for information.

AIRETOOL MANUFACTURING COMPANY

SHUEY BLDG., DEPT. R
SPRINGFIELD, OHIO



PREMIUM MOTOR GASOLINE AND DOMESTIC FURNACE OIL FROM HEAVY GAS OIL STOCK

HIGH T.C.C. YIELDS

of Premium Motor Gasoline and Domestic Furnace Oil from Heavy Gas Oil Stocks

. . . Heavy East Texas gas oil over an asphalt bottom . . . 90% at 900°F. . . . end point 970°F. . . . 90° pour . . . 28 A.P.I. gravity. Yield: 49% of 10 lb. R.V.P. 400 end point gasoline, 80 A.S.T.M. octane number clear . . . 33% domestic furnace oil . . . once *through* a T.C.C. Unit.

. . . Heavy paraffin gas oil . . . 445 to 1000°F. boiling range, obtained from vacuum distilling down to asphalt bottoms. Yield: 54% of 10 lb. R.V.P., 400 end point gasoline, 80 A.S.T.M. octane number clear . . . 27% domestic furnace oil with ½ to 1 recycle through a T.C.C. Unit.

T.C.C.* Units most effectively process deasphalted heavy stocks for the production of high yields of high quality motor gasoline and domestic furnace oil—also heavy oils produced from coke still or visbreaker operations.

Thermofor Catalytic Cracking, outstanding in its performance record for aviation gasoline production, will be the selected process for post-war operations because of — lower investment and operating costs, higher yields of quality products from all charge stocks including the very heavy gas oils. The gasoline is stable, has good lead susceptibility and has low sulfur content, even from high sulfur bearing charge stocks, and the domestic furnace oil is stable and saleable without further treatment.

THE LUMMUS COMPANY, 420 Lexington Ave., New York 17, N. Y.

600 S. Michigan Ave., Chicago 5, Illinois • 634 S. Spring St., Los Angeles 14, California
Mellie Esperson Building, Houston 2, Texas • 70 Barn Hill, Wembley Park, Middlesex, England

*Licensed by Houdry Process Corporation

LUMMUS

PETROLEUM REFINING PLANTS

A LESSON IN WATER COOLING

LESSON 10 OF A SERIES

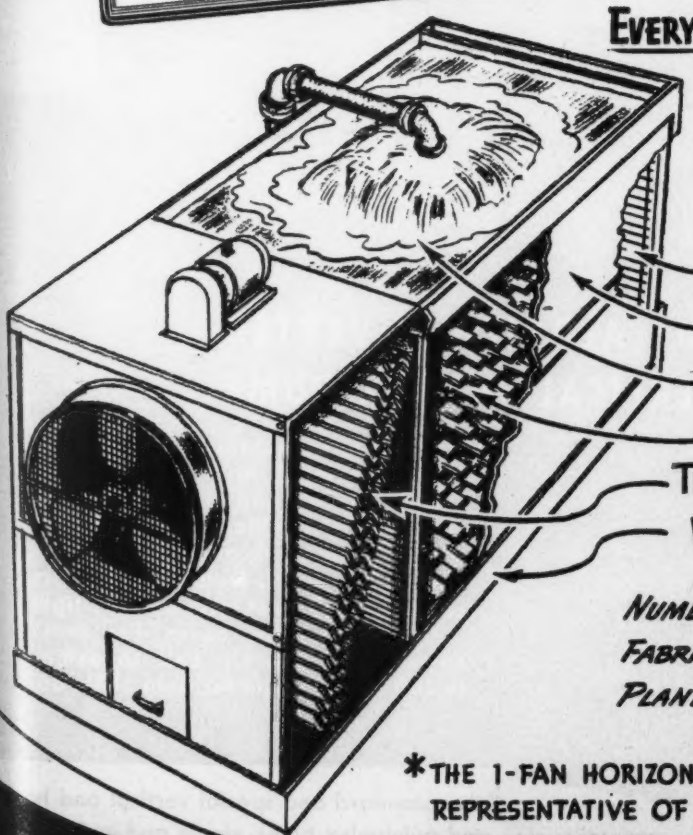
DESIGN AND CONSTRUCTION OF WOODEN PARTS

Wood is utilized more than any other material in the construction of present-day water cooling towers. The selection of the right kind and grade of lumber therefore is of great importance. The *proper* designing, fabricating and framing of this lumber into parts, however, is not only important but imperative if the tower as a whole is to function most effectively and have a long, trouble-free life with a minimum of maintenance and operating care.

The perfections and additional cost incorporated into the wooden parts of a cooling tower (or the lack of them) are easily overlooked and seldom given due consideration by the purchasers of this equipment. It is into these parts that the manufacturer soundly builds quality and long life—or may omit them without necessarily affecting cooling performance *within the guarantee period.*

In addition to the main framing, the wooden parts of a cooling tower consist essentially of the casing, the filling, the inlet louvers, the drift eliminators, the distribution system, the water basins, and the fan decks with housings. The alternate conditions of wet and dry, hot and cold plus the severe mechanical and structural demands that constitute cooling tower service do not only call for lumber of excellent grade but also for manufacturing skill and experience of high order. The following specifications can be used to check and measure the correctness of design, the quality of workmanship and the proper construction of these parts.

1. Nails eliminated wherever possible.
2. Provision is to be made for the expansion and contraction of the lumber, and in such a manner as not to impair the function or efficiency of the part.
3. Parts and pieces are to be securely held in place and alignment by the proper type and spacing of supports or fastenings.
4. Parts are to be accessible for inspection and, where desirable, easily removable.
5. Designs and construction shall preferably be pre-tested by field service.
6. Parts shall be shop fabricated and standardized methods employed.
7. All parts shall be of sufficient size as to guarantee proper structural strength for the loads and service imposed.
8. Proper type and grade of lumber shall be selected for the service required of the particular part.



EVERY WOOD PART IN EVERY MARLEY TOWER* MEETS THE RIGID SPECIFICATIONS ABOVE

EACH INVITES DETAILED INSPECTION AND COMPARISON:

- SLIP-FIT AIR INLET LOUVERS
- DOUBLE-WALL CASING, PANEL UNITS
- EXTERNAL WATER DISTRIBUTION
- MORTIS LOCKED NAIL-LESS FILLING
- THREE-PASS NAIL-LESS DRIFT ELIMINATORS
- WATER CATCH BASIN

NUMEROUS EXCLUSIVE ADVANTAGES. . . PARTS ARE FABRICATED IN MARLEY'S COMPLETE WOOD-WORKING PLANTS AT STOCKTON, CALIF., AND KANSAS CITY, KANS.

*THE 1-FAN HORIZONTAL INDUCED DRAFT TOWER PICTURED HERE IS REPRESENTATIVE OF ALL TYPES AND SIZES OF MARLEY TOWERS AS REGARDS DESIGN AND ADVANTAGES OF WOOD PARTS.

MARLEY COOLING TOWERS

THE MARLEY COMPANY INC.
KANSAS CITY, KANSAS

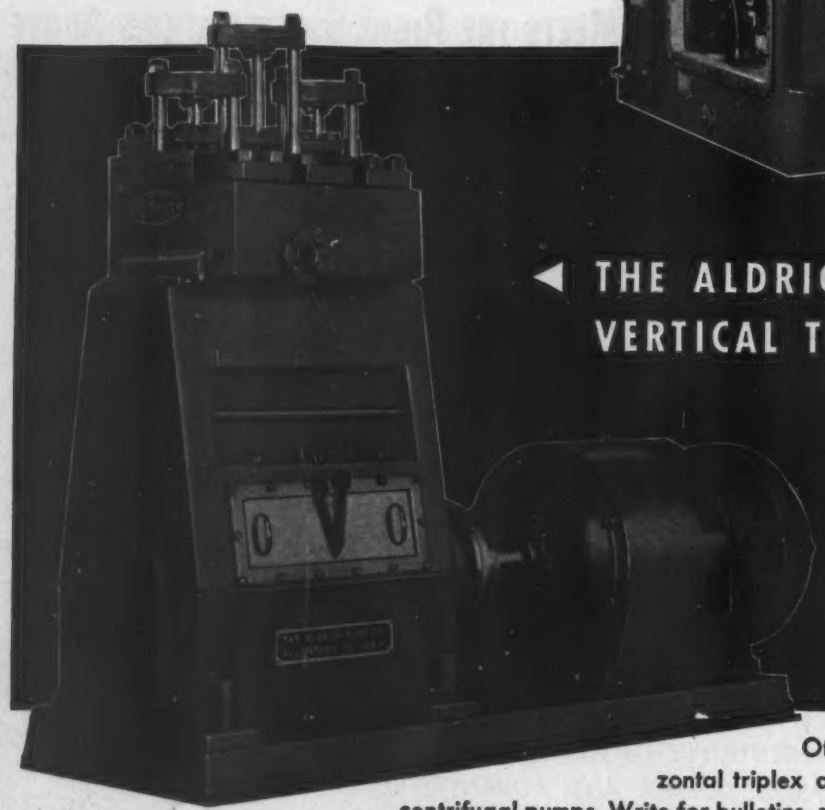
112-A

2 unique PUMPS FOR THE OIL INDUSTRY

- **PIPE LINE SERVICE**
- **PROCESS AND STILL CHARGING**
- **PROPORTIONING**
- **CENTRALIZED PUMPING**

THE ALDRICH-GROFF "POWR-SAVR" CONTROLLABLE CAPACITY PUMP

High mechanical reliability combined with low power consumption proportional to varying output demands and a ready accessibility of all totally enclosed and pressure lubricated parts have made this pump a favorite with oil operators. Provides for automatic or remote manual control of delivery from zero to full rated capacity at constant pump speed. For pressures from 200 to 15,000 p.s.i. Write for Data Sheet 65.



◀ THE ALDRICH INVERTED VERTICAL TRIPLEX PUMP

Fluid end located at top of pump frame. Totally enclosed with provision for outside packing and lubrication under all operating conditions. Crankshaft extends through crankcase for direct coupling at floor level. Outboard plungers can be sealed dust and weather tight with a removable cover. For pressures to 8350 p.s.i. and capacities to 200 G.P.M. Write for Data Sheet 66.

Other standard and special vertical and horizontal triplex and quintuplex types; single and multi-stage centrifugal pumps. Write for bulletins, giving details of your specific pumping needs.

THE ALDRICH PUMP CO. ALLENTOWN • PENNA.

LAYING THE LIFE LINE OF OUR ADVANCING ARMIES

Many miles of Talon's Electric Welded Steel Tubing connect supply bases with combat areas. Known as "invasion lines," these vital arteries carry the "blood stream" of our mechanized forces—gasoline, oil, and water. Each type of product flows through separate 4" lines at a 6,000 bbl. daily rate. The requirements of such installations are light weight for ease and speed of placement in the field, and great strength to withstand the shocks of battle. Talon's tubing is successfully passing this rigid test.

The lines are laid in 20' sections, each weighing only 70 lbs. The light weight enables a skilled crew to lay up to 10 miles per day. Extra heavy nipples are welded onto the light wall tubing for coupling in the field. Another indication of the great strength of Talon's tubing—the lines follow natural contour of the land without trenching.

Talon's Electric Welded Steel Tubing, both pressure and mechanical, is available for prompt delivery in sizes from 5/8" to 4" O. D. in lengths up to 40 feet.

PRESSURE MECHANICAL

TALON . . INC.

STEEL TUBE DIVISION OIL CITY, PENNA.

Brown "CONTINUOUS
Revolutionizes Temperature

A New Aid to Process Control

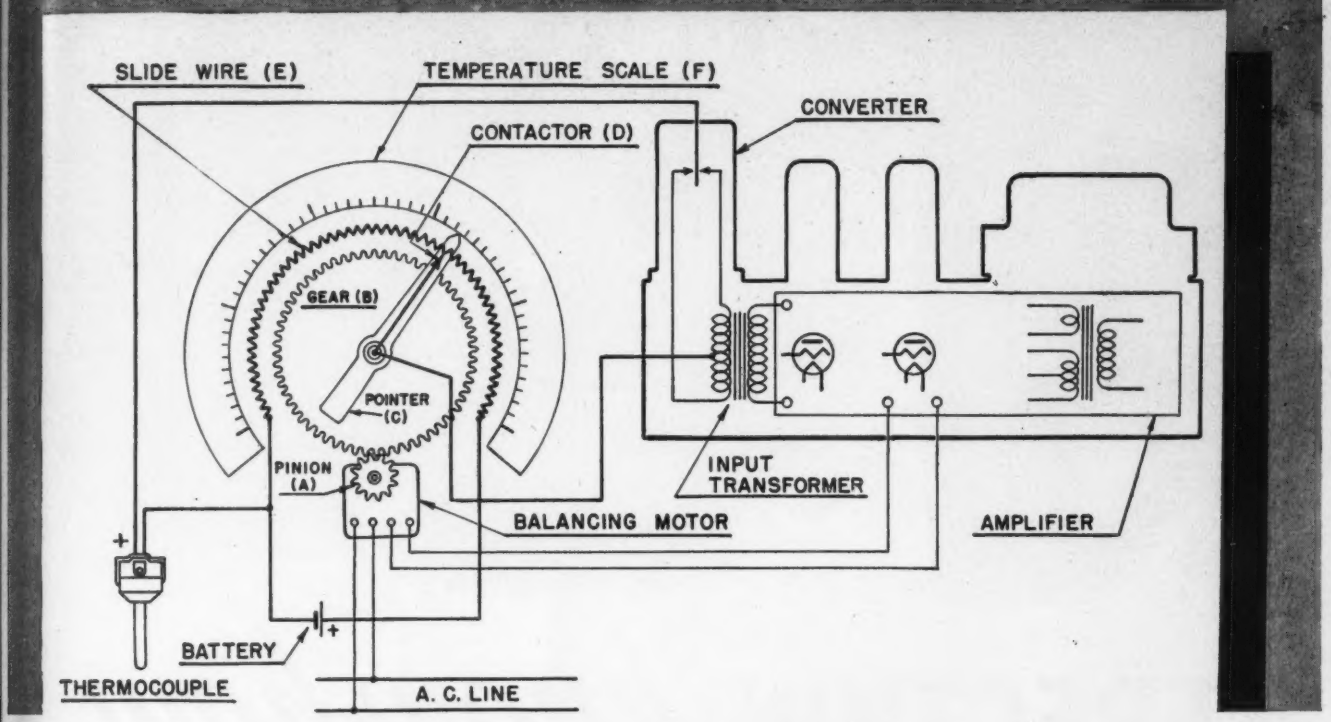
The new Brown (Circular Chart) Potentiometer Controller, incorporating this exclusive Brown principle, is the only Potentiometer-Type instrument in which the air control flapper mechanism is *continuously positioned* in response to temperature changes.

Combining sensitivity . . . ruggedness . . . simplicity . . . precision and unequalled ease of adaptation to process requirements, the new Brown Circular Chart Air-Operated Potentiometer Controller is the result of years of research, design and field testing. You can rely on its accuracy and be confident of its dependability.

BROWN *Electronic*

Operates on "CONTINUOUS

BALANCE" Principle
Measurement and Control



SEMI-PICTORIAL DIAGRAM OF OPERATING PRINCIPLE

THIS new Operating Principle employs a conventional null-balance measuring circuit, but differs basically from the usual self-balancing Potentiometer Systems in its balancing operation.

Instead of the usual galvanometer and its associated mechanisms, the Brown Continuous Balance Unit is used—a compact, interchangeable assembly consisting of a Conversion Stage and Amplifier.

Referring to diagram above—Balancing Motor Pinion "A" drives Gear "B" which is *directly connected* mechanically to Indicating Pointer "C," Recording Pen, and slide-wire Contactor "D," hence the balancing motor instantly readjusts the Contactor when required to a new position balancing the measuring circuit.

From the foregoing, it will be seen that the balancing operation continuously keeps pace with changes in the thermocouple voltage—there being no cyclic mechanical motion, no delay is introduced before corrective action can be taken.

Any unbalance between the thermocouple and slide wire voltages, as caused by a temperature change at the thermocouple, is converted into an alternating voltage by the conversion stage (a combination of Converter and Transformer) of the Continuous Balance Unit.

This alternating voltage is amplified to such an extent as to secure maximum driving power for a minute unbalance. The phase of the alternating voltage is dependent upon the direction of potentiometer unbalance, and is recognized by the Balancing Motor, thus determining direction of rotation.

The Balancing Motor is a reversible, variable speed induction motor, one winding of which is continuously energized by line voltage, the other energized by the amplified alternating voltage, whose phase with respect to the line voltage determines the direction of rotation of the balancing motor.

This Continuous Balance System, providing *sensitivity* of detection, *ruggedness* and *simplicity* of construction, and *precision* in measurement, is incorporated in the new Brown Circular Chart Potentiometer.

For information write THE BROWN INSTRUMENT COMPANY, *a division of Minneapolis-Honeywell Regulator Co.*, 4498 Wayne Avenue, Philadelphia, Pa. Offices in all principal cities. Toronto, Canada: 117 Peter Street—England: Wadsworth Road, Perivale, Middlesex—Stockholm, Sweden: Nybrokajen 7.

POTENTIOMETER
BALANCE" *Principle*

ERECTION *know-how*

an important Armstrong EXTRA

TWO THINGS make for lasting efficiency on any low-temperature insulation job . . . the efficiency of the insulating material itself, and the skill with which that material is erected. You get both when you specify "insulation by Armstrong."

At "Insulation Headquarters" you have a complete range of efficient materials to choose from—Armstrong's Corkboard and Cork Covering, Foamglas, and Mineral Wool Board. Thus you can be sure that Armstrong's engineers will specify the material best suited to your needs. Their recommendations will be sound because they have a background of over 40 years' experience in low-temperature insulation work.

The all-important extra you get is the complete follow-through that Armstrong provides *after* you've chosen a material. This is possible first, because Armstrong has offices and distributors spotted in strategic locations all over the country, and second, because all of these offices maintain complete crews of skilled mechanics who are specialists in erecting low-temperature insulation.

These experts have the know-how needed to meet any unusual problem of construction encountered on the job. When they erect insulation you can be *sure* the job is right—sure that it will deliver efficient, lasting service.

Remember this plus value the next time you consider insulation and bring your problems to "Insulation Headquarters." But don't wait until then to get the facts about Armstrong's Insulation. Write today! Armstrong Cork Company, Building Materials Division, 7512 Concord Street, Lancaster, Pennsylvania.

ARMSTRONG CORK COMPANY

Insulation Headquarters

KEY RETURN BENDS AND FITTINGS ALL OVER THE WORLD

You will find Key Return Bends and Fittings in almost every country where oil refineries operate.

Key Fittings are carefully engineered and tailor-made—not just standard "run of the mill" products.

Now—with no replacements available to isolated plants and no time to spare for repairs—this is more important than ever before.

Use our many years of experience to help you decide the exact type of return bends best suited for your job.

The illustrated fitting is our type 1900. Our technical bulletin service covers the entire subject of return bend fittings. Are you on our mailing list?

We Are . .

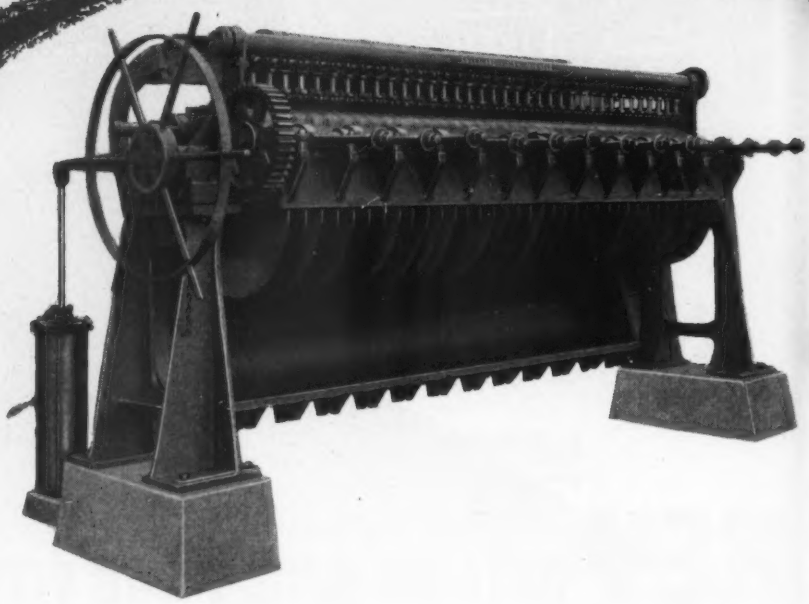
ENGINEERS
MACHINISTS
STEEL FOUNDERS
FABRICATORS
HEAT TREATERS

KEY COMPANY • EAST ST. LOUIS, ILLINOIS

NEW YORK • CLEVELAND • CHICAGO • TULSA • HOUSTON • LOS ANGELES

KEY COMPANY

OUF Specialt



ADD *"Continuous Pressure Filtration"* to the headline and you have a ten-word picture of the scope of filtration and clarification service offered by Oliver United engineers. From them you can obtain experienced advice on such problems and you can select from a wide variety of:

BATCH PRESSURE FILTERS

CONTINUOUS PRESSURE FILTERS

CONTINUOUS VACUUM FILTERS

plus

The Oliver Precoat Method of Continuous Filtration which long ago proved itself best for handling certain materials difficult to filter on standard pressure or vacuum filters.

New York 18, N. Y.
33 West 42nd Street

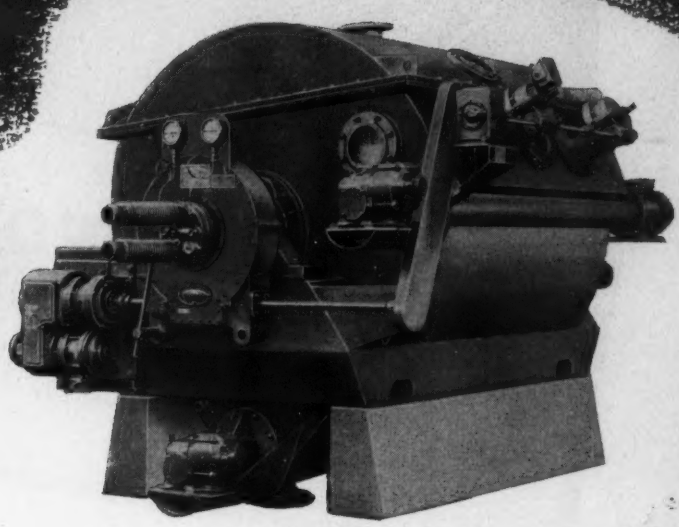
Chicago 1, Ill.
221 No. LaSalle Street

Western Sales Division
Oakland 1, Calif.
2900 Glascock Street

San Francisco 11, Calif.
260 California St.

Canada: E. Long, Ltd.
Orillia, Ont.

in PRESSURE and CONTINUOUS VACUUM FILTRATION



To all the pioneering work done by Oliver United engineers in connection with refinery filtration and clarification problems, can now be added pioneering work in the synthetic rubber field. A special Oliver Filter was designed for its operations and many of these filters are now in service. . . . Yes, Oliver United engineers are the ones who can bring you years of experience on filtration and clarification problems throughout industry generally and the petroleum industry in particular. Why not call on this experience?

OLIVER UNITED FILTERS INC.

Factories: Hazleton, Pa. — Oakland, Calif. — Orillia, Ont., Canada — Melbourne, Australia
Cable Address: OLIUNIFILT

NO GUESSWORK PERMITTED

Ross Heater and Manufacturing Company, Inc. BCP Tube Bundle. Navy Type for Sea Water Service. Anaconda Cupro Nickel Tubes and Tube Sheets Brass Baffles, Tie Rods and Spacers.

In the construction of costly engineering equipment such as heat exchangers and condensers, nothing should be left to chance. Considering engineering time, labor and materials and the consequences of unsatisfactory performance, guesswork is much too costly.

That is why manufacturers of this type of equipment confer with the Engineers of our Technical Department when it comes to selecting condenser tubes. Not only have these Engineers devoted years to the metallurgy of tube alloys, but also to the study of the complex conditions under which condenser and heat exchanger tubes must serve —such factors as the character of the cooling water, turbulent flow, excessive velocities and entrained air. Their suggestions and vast fund of experience have helped many tube users obtain maximum value.

4398

A wide range of tube alloys for condenser and heat exchanger installations is available from The American Brass Company. They are fully described in Condenser Tube Publication B-2, which will be sent on request.

ANACONDA

Anaconda Condenser Tubes

THE AMERICAN BRASS COMPANY • General Offices: Waterbury 88, Connecticut

Subsidiary of Anaconda Copper Mining Company • In Canada: Anaconda American Brass Ltd., *New Toronto, Ont.*

BUY ALL THE BONDS YOU CAN AFFORD . . . TURN IN ALL THE SCRAP YOU CAN FIND

It's a *long time* Between Replacements with

ALOYCO VALVES

STAINLESS STEEL

Today's shortage of manpower and materials makes it essential that you ask, "Will it last?" before you okay an order. It is characteristic of ALOYCO VALVES that they stand up under severe service. There has been no sacrifice in the quality of materials or workmanship for quantity production of Aloyco Valves. Experienced foundry practice, accurate machining and rigid inspection insure the maintenance of high standards of excellence.

ALOYCO VALVES permit widely varying piping layouts because they are made in a complete range of types and sizes as well as alloys.

We can supply ALOYCO VALVES and FITTINGS in materials most suitable for your application. Send us your inquiries.

Stainless Steel VALVES and FITTINGS

GATE VALVES • GLOBE VALVES
Y VALVES • CHECK VALVES
LEVER THROTTLE GATE VALVES
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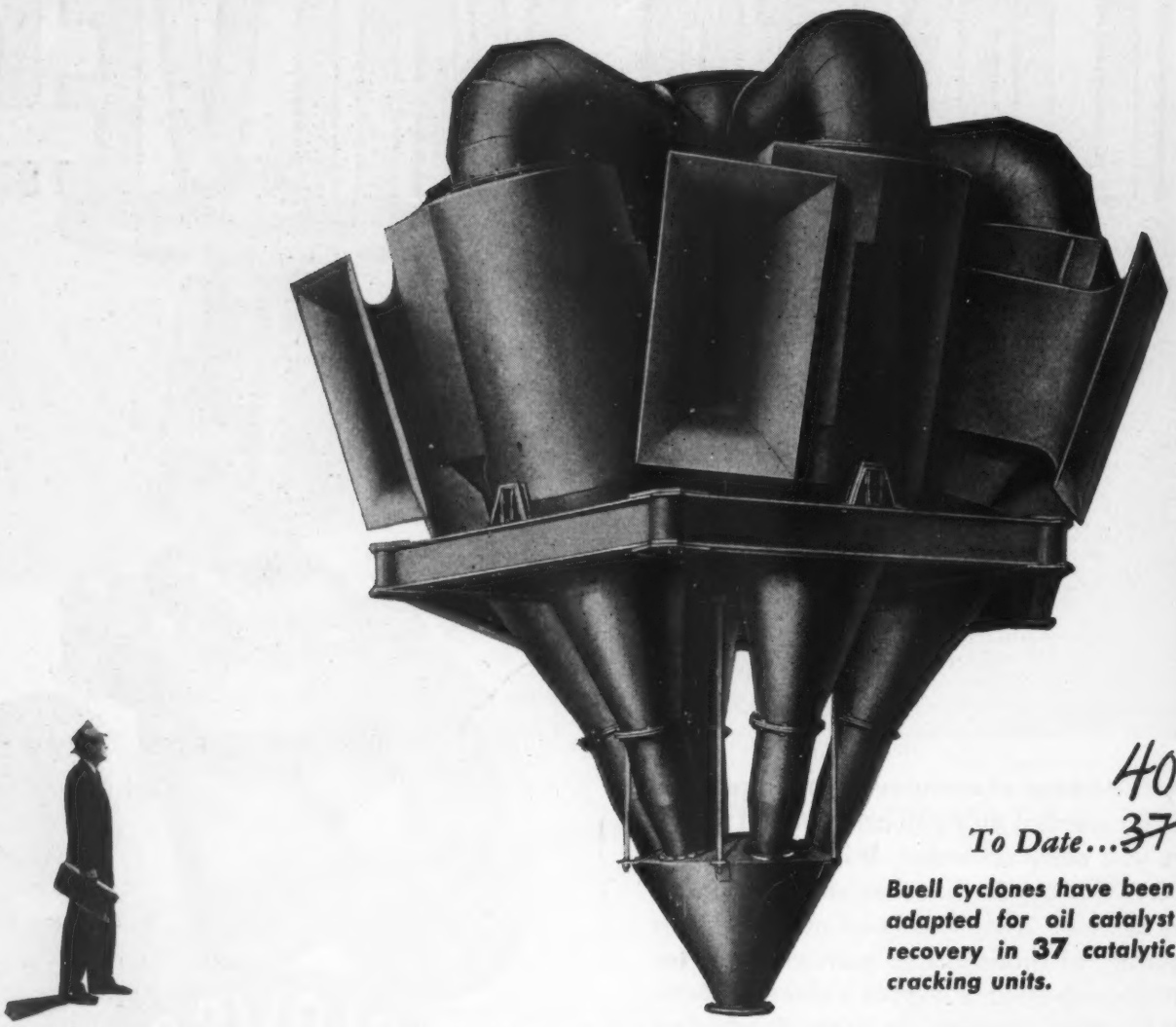
Alloy Steel Products Company, Inc., 1300 West Elizabeth Avenue, Linden, N. J.

Aide-de-Camp to a

"CAT CRACKER"



40

To Date...~~37~~

Buell cyclones have been adapted for oil catalyst recovery in 37 catalytic cracking units.

Buell Dust Recovery Systems help make 100-octane gas...

"CAT CRACKER" is the oil industry's nickname for the new catalytic cracking processes now producing high-octane gas—processes calling for the highest efficiency in the recovery of catalyst dust. It is significant that so many leading oil companies have chosen Buell (van Tongeren) Dust Recovery Systems for this important work.

The remarkable natural and synthetic catalysts used are both expensive and abrasive. Buell equipment (incorporating the exclusive van Tongeren "shave-off") pays for itself many times over in the recovery of the costly, finely divided catalyst. And Buell's large-diameter, extra-heavy metal cyclones eliminate clogging and reduce abrasive wear—for long life and continuous performance.

Here, as in so many other fields, Buell leadership has again demonstrated its ability to solve difficult dust recovery problems.

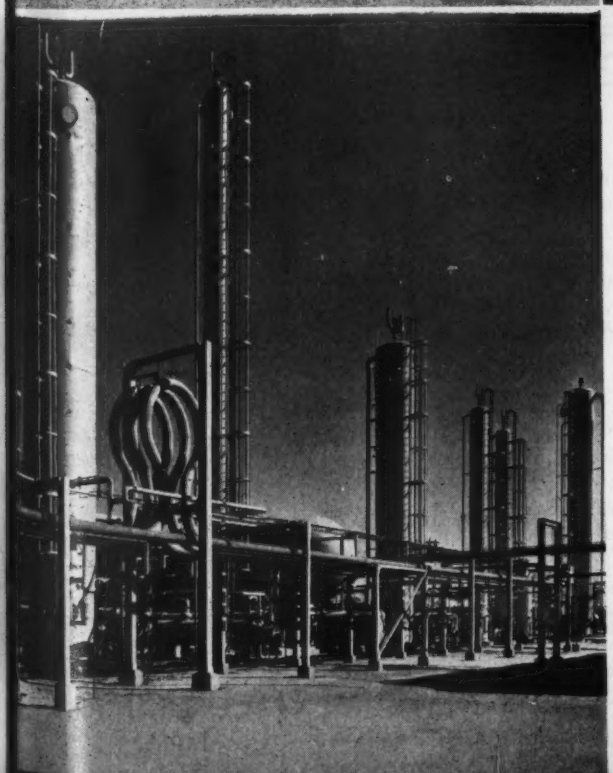
For a complete description of the theory and operation of the Buell (van Tongeren) cyclone, write for Bulletin G-842.

BUELL ENGINEERING COMPANY, INC.
Suite 5000, 6 Cedar Street, New York 5, N. Y.
Sales Representatives in Principal Cities

buell
DUST RECOVERY SYSTEMS

BUY WAR BONDS AND MAKE THE AXIS BITE THE DUST

HUDSON-BUILT PLANTS PRODUCING "Fuels for Freedom"



In refineries, distillate fields and oil fields in Texas, Oklahoma, Illinois and Louisiana, Hudson plants or equipment are contributing to the tremendous and constantly increasing flow of fuels for war, including high purity propane, butanes, pentanes, and closely fractionated high octane aviation blending stocks.

To the refining, producing and gas industries we offer the services of an integrated engineering and construction organization qualified by experience to complete, in minimum time, projects of any size—either independently or in collaboration with our client's engineering departments.

HUDSON ENGINEERING CORPORATION

Engineers and Constructors

FAIRVIEW STATION • HOUSTON, TEXAS

pressure GAGES

PRESSURE GAGES FOR TOMORROW'S INDUSTRY

Today's battles of war are being won by those who are most intelligently using the best instruments of war.

Tomorrow's battles within industry will likewise be won by those adapting to their own problems the best available instruments of industry.

The Clapp Acragage is a precision-built indicating pressure gage with refinements and improvements that are exclusive. It is offered in standard models, or can be custom-built to your individual needs.

The highly trained Clapp Experimental Department will gladly work out with you now, exactly the gage you need to jump into the Post-War Period with a headstart on competition.

CLAPP INSTRUMENT COMPANY
WEBSTER MASS.

Clapp WEBSTER MASS

BECAUSE *"nothing else will do"*

Even though *you* haven't been able to get it, you might suppose that aluminum paint has been supplied without question for Army and Navy uses. Not so! Before any aluminum pigment could be released, the WPB had to be convinced that no other paint would do the job.

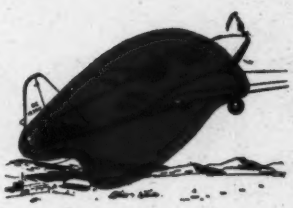
The approved jobs have ranged from painting aircraft spark plugs for rust prevention to coating degaussing cables which protect ships from magnetic mines. Some of the uses are shown below.

We wish we could show you the glowing testimonials written on the requests for authorization we get for releasing Alcoa Albron Pigment. The reasons given are all good reasons why, as it becomes available, you'll be using aluminum paint again.

WPB RELEASES ALUMINUM PAINT

A limited quantity of aluminum pigment, made from a war by-product, has been released for making aluminum paint "for industrial maintenance and essential civilian requirements". Get in touch with your paint supplier for details.

Barrage balloons for air raid defense, and blimps for submarine defense, are coated with aluminum paint to protect the fabric and reflect sun heat and, thus, reduce expansion and contraction of the gas inside.

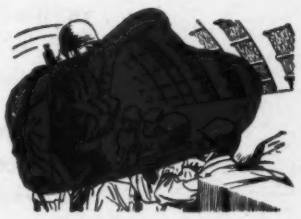


The surface of plywood trainer planes is painted with aluminum paint to provide lasting protection and prevent raising of the wood grain. It resists moisture and the action of sunlight.

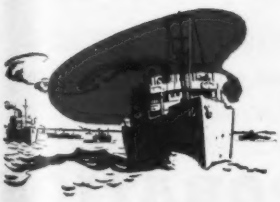
The Navy employs aluminum paint on ammunition boxes and magazines, gun control parts, target designators, gun sight lamps, spare parts boxes, and other purposes connected with gunnery.

In field hospitals, aluminum paint is found on the interior of instrument sterilizers because it resists heat and moisture. It is also used to protect other surgical equipment.

Bombers and fighter planes have aluminum paint on motors, running lights, landing gear struts, wheels, ailerons, radio antennae parts, instrument panels and other places.



In addition to the other applications mentioned on bombers and fighters, aluminum paint is used on floor sections, benches, radiators and other parts of the interior of giant troop transport planes.



Warships and transport vessels use aluminum paint on heated surfaces of all kinds. Alcoa Albron Pigment is also used in a caulking compound to waterproof metal-to-metal joints.

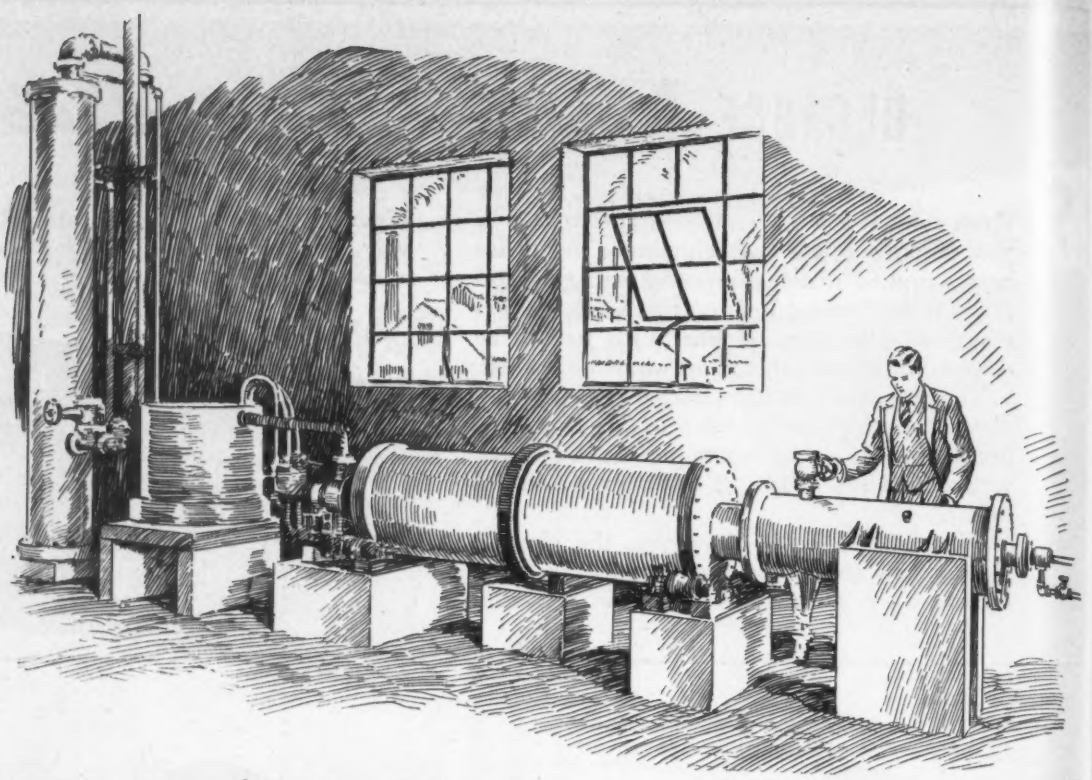
There are many applications for aluminum paint on panels, chassis, cabinets, and tubes for radio and other electronic devices used by the Army Signal Corps and other armed services.

ALCOA ALUMINUM ALBRON

ALUMINUM COMPANY OF AMERICA

1951 GULF BUILDING, PITTSBURGH, PA.

MAKERS OF ALCOA ALBRON PASTE, MADE UNDER PATENTS OF METALS DISINTEGRATING COMPANY, INC.



Part of a CHEMICO Sludge-Conversion-Process Pilot Plant

CHEMICO

can help you plan ahead

Many of the new petro-chemical processes involve the use of sulphuric or other acids . . . frequently in large quantities.

How can the acid best be produced . . . concentrated . . . purified . . . recovered? These are the questions that arise . . . and in some cases, the correct answer may mean the difference between a profitable plant and an unprofitable one.

CHEMICO is prepared to give authoritative advice on acid production and recovery . . . based on 29 years of extensive experience, the results obtained in scores of CHEMICO acid plants, and the unequalled facilities and resources of one of the oldest and largest organizations of acid plant specialists in the world.

Your inquiry is invited without obligation and with the assurance of strictest confidence.

CHEMICAL CONSTRUCTION CORPORATION

30 ROCKEFELLER PLAZA • NEW YORK 20, N. Y.

Cables, Chemiconst, New York • European Representatives, Cyanamid Products, Berkhamsted, Herts., England

CHEMICO PLANTS are PROFITABLE INVESTMENTS

Simplifies Purchasing and Layouts

By specifying a factory-assembled group for your high-voltage control, you consolidate the selecting, ordering, and laying out of individual devices into one simplified process—saving hours for your engineers, purchasing men, and draftsmen.

Saves Installation Time and Space

Instead of separate devices, you install only one control board. The individual starters, each combining an oil-immersed contactor and EJ-2 fuses in a single metal cubicle, are pre-assembled into a compact group, which is wired and shipped as a complete panel. Just set it in place and connect the incoming line and outgoing motor leads.

Conserves Critical Material

Because of the compact arrangement of these starters into a group, you save the vital material that would be used for bus, conduit fittings, and wire connections on separately installed controls.

For further information, get in touch with the nearest G-E office. One of our sales engineers will be glad to help you select 2300-volt control for your plant. *General Electric, Schenectady, N. Y.*

676-91-8920

GROUP CONTROL FOR CORROSIVE OR SEMIHAZARDOUS LOCATIONS

For full-voltage or reduced-voltage starting of induction or synchronous motors which drive pumps, blowers, compressors, and other equipments, indoors or outdoors. Individual starters can be supplied for isolated locations.

GENERAL ELECTRIC

CONTROL

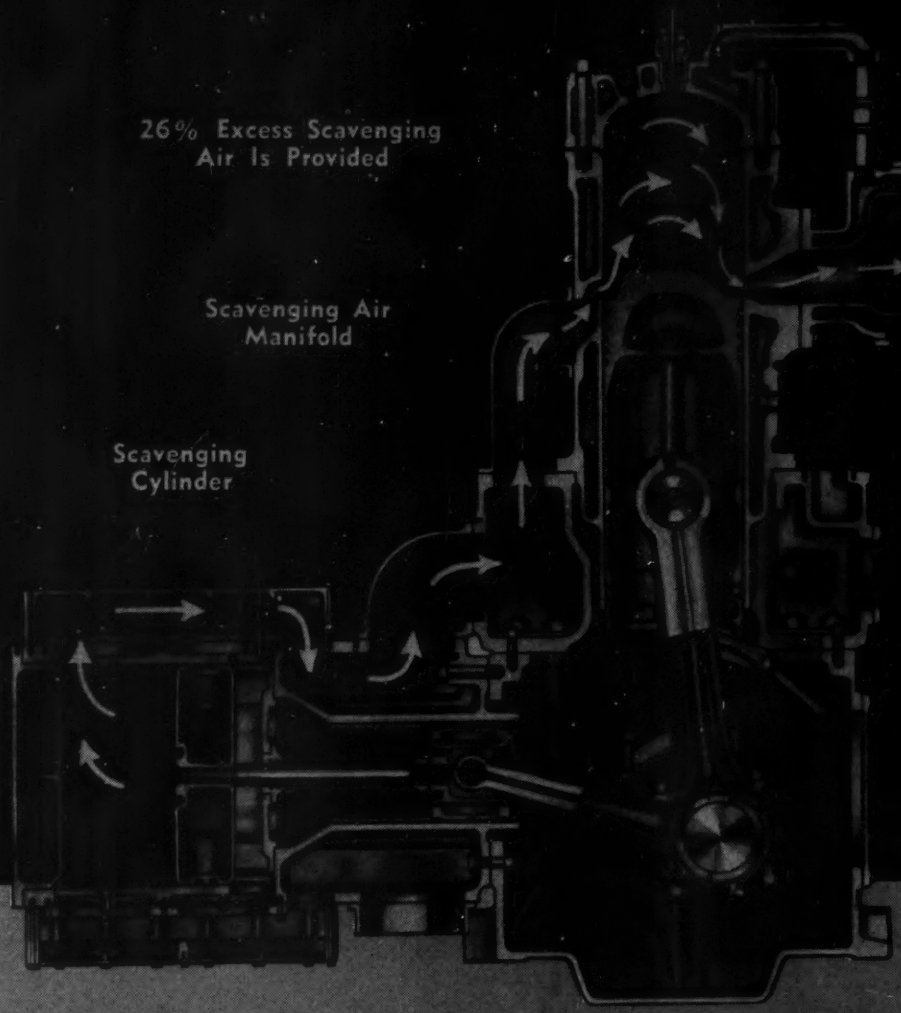
CHAPMAN List 960

QUICK-ACTING THREADS BRING IT UP AND PUT IT DOWN PRONTO!

When you reach for the wheel of this small steel gate valve, you're reaching for fast action, brother! And here's why. Both inside and outside screw types are built with quick-acting threads that open and close at the turn of a hand . . . won't stick or freeze . . . won't jam up transportation or processing.

You're also shooting for longer wear when you specify Chapman 960. Tough seats and plugs give it longer life than any other similar type of small valve. And if you have extra severe service, you can have these parts *super-hardened* by an exclusive Chapman process that adds extra long life. Standardize on this sturdy valve for all small field and refinery lines from ¼" to 2" . . . and cut down on your trouble-shooting!

The
CHAPMAN VALVE
MANUFACTURING COMPANY
INDIAN ORCHARD, MASS.



2-CYCLE *delivers* MAXIMUM POWER

Induction of the Charge, Compression and Exhaust, with every stroke of the Clark 2-Cycle Engine. No waste or loafing on each alternate stroke as with 4-Cycle.

That's the secret of the continuous power delivery of Clark 2-Cycle.

But it took years of experiment to hitch those three functions to every stroke of the piston — revolutionary developments in porting and scavenging the Clark 2-Cycle Cylinders.

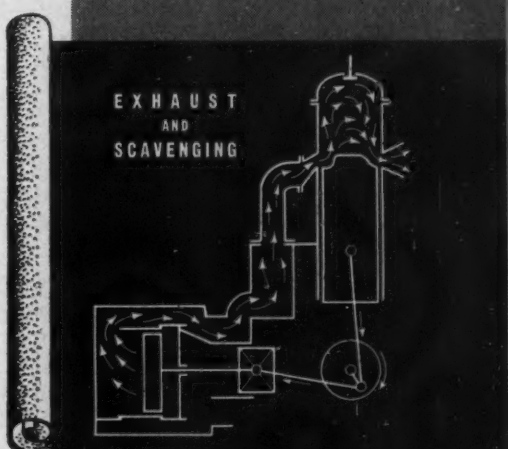
The end justified the means, for today the success of the Clark 2-Cycle design rests solidly on actual power performance in the field.

CLARK BROS. CO., INC., OLEAN, N. Y.
Export Offices: 30 Rockefeiler Plaza, New York. Domestic Sales Offices and Warehouses: Tulsa, Okla., Houston, Texas; Chicago, Ill. (122 S. Michigan Ave.); Boston, Mass. (131 Clarendon St.); Huntington Park, Calif. (5715 Bicket St.) Foreign Offices: 72 Turnmill St., E. C. 1, London; Avda Roque Saenz Pena 832. Buenos Aires.

CLARK

Super-2-Cycle

AFFILIATED COMPANIES: Dresser Mfg. Co., Bradford, Pa.; Pacific Pump Works, Huntington Park, Calif.; Bryant Heater Co., Cleveland, O.



CLARK 6-Cylinder 600 H.P. "Angle" Compressor

ALL HANDS AT
PROCESS ENGINEERING AND DESIGN

BATTLE STATIONS!

PROCUREMENT AND CONSTRUCTION

INITIAL PLANT OPERATION

War is still America's most serious business of the moment. Industrial efficiency is high—but not high enough. Production is huge—but still short of goals. Both objectives demand the redoubled effort of every loyal individual and concern.

BADGER is knee-and-elbow-deep in the kind of large-scale work for which Badger's long experience is particularly suited. Since Pearl Harbor—and before—Badger services have been heavily engaged in process engineering, design and construction for both Government and private war-production plants in the petroleum, petro-chemical and chemical fields.

The total number of Badger employees engaged on war projects to date would populate a small city. The many construction operations in which Badger has had an important part during the past three years extend through many states and foreign countries. They represent a value approximating the cost of several "Alcan" highways.

Conspicuous are plants for the manufacture of butadiene, alcohol, toluol, tri-nitro-toluene, plus many complete refineries for the production of aviation gasoline.

Badger is thoroughly equipped and manned to assume full responsibility for the complete handling of any size project, from inception to final test-run operation. Around the key personnel of Badger's central organization are technical and laboratory engineers; design engineers and draftsmen; procurement, expediting and accounting experts; seasoned and efficiently supervised construction crews; experienced plant operators.

All these combine to afford the many advantages to be gained from placing everything in the hands of one qualified concern working in close co-operation with your own organization.

Process Engineers and Constructors for the Petroleum, Petro-Chemical and Chemical Industries.

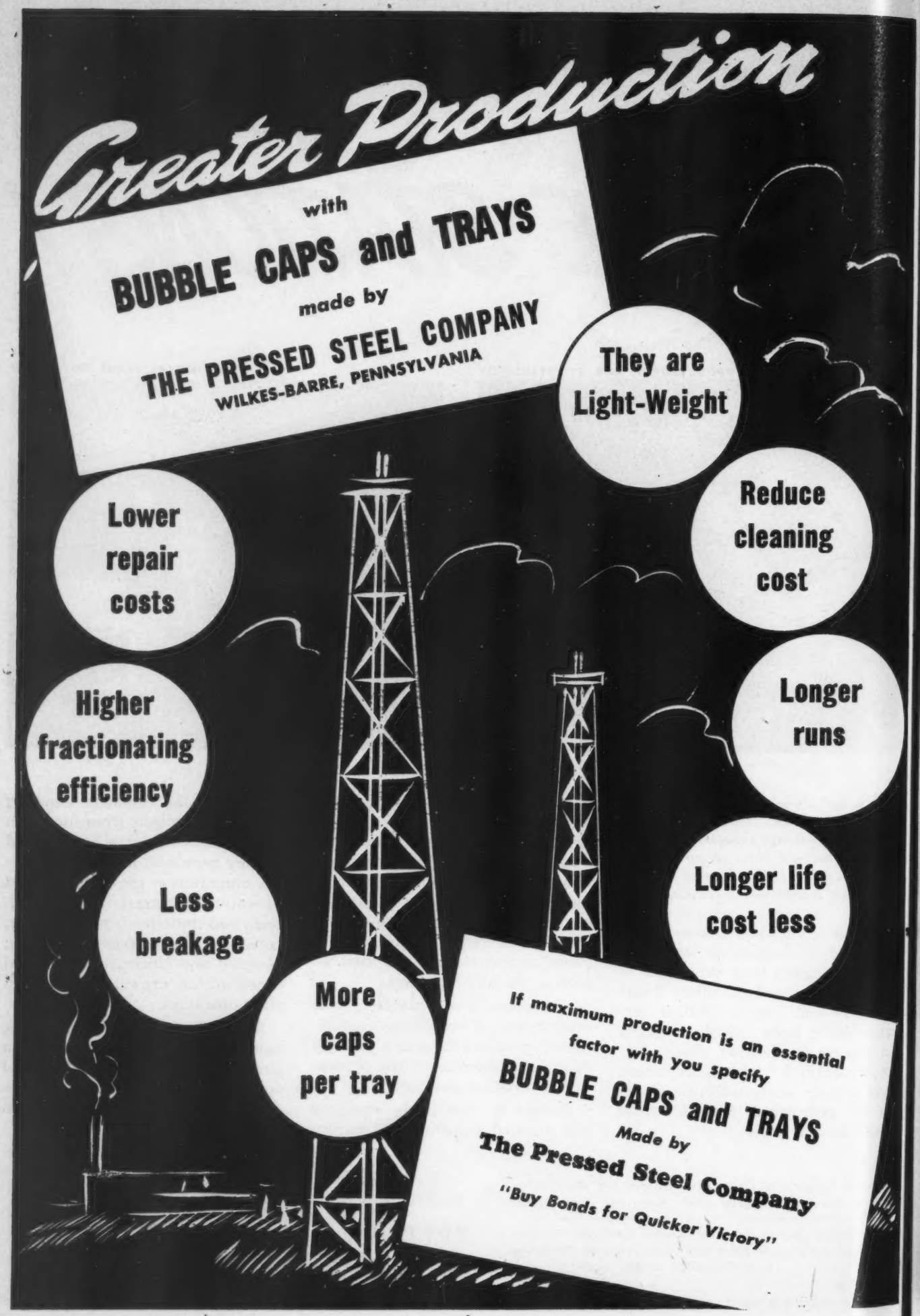
• Licensing Agents for the Houdry Catalytic Cracking Processes; All-purpose Fixed Bed Units, Adiabatic Fixed Bed Units, Thermofor Units.

E. B. Badger & SONS CO.

BOSTON **EST. 1841**

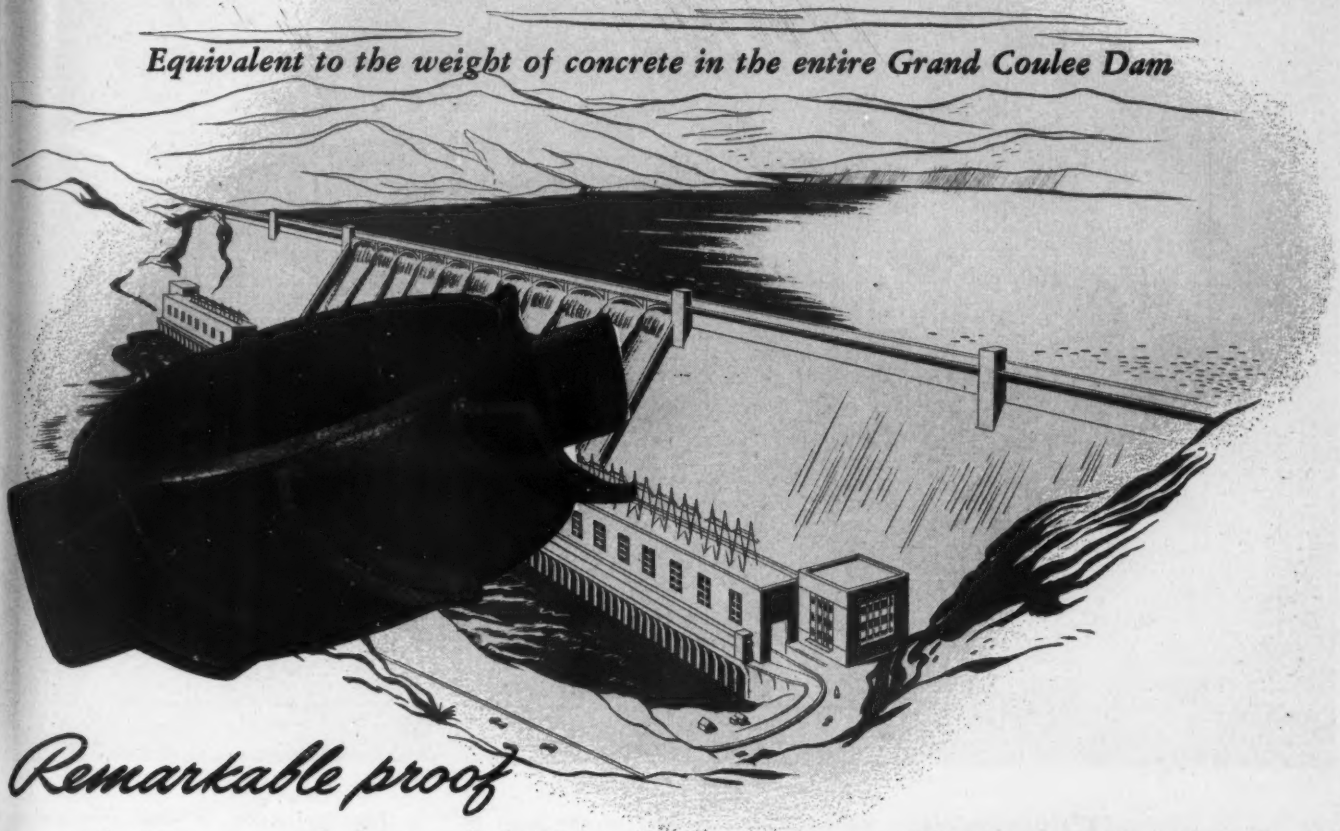
New York • Philadelphia • San Francisco • London

BADGER HAS DESIGNED AND BUILT MORE CATALYTIC CRACKING UNITS THAN ANY OTHER ORGANIZATION IN THE WORLD


Greater Production
with
BUBBLE CAPS and TRAYS
made by
THE PRESSED STEEL COMPANY
WILKES-BARRE, PENNSYLVANIA
They are Light-Weight
Reduce cleaning cost
Longer runs
Longer life cost less
More caps per tray
Less breakage
Higher fractionating efficiency
Lower repair costs
If maximum production is an essential factor with you specify
BUBBLE CAPS and TRAYS
Made by
The Pressed Steel Company
"Buy Bonds for Quicker Victory"

25 *Million Tons* handled by a MULTICLONE Catalyst Recovery System!

Equivalent to the weight of concrete in the entire Grand Coulee Dam



Remarkable proof of the rugged dependability of MULTICLONE Recovery Equipment!

A MULTICLONE Catalyst Recovery System using this type of vane and installed in one of the first catalyst recovery plants to go into commercial operation more than a year ago, has handled over 25,000,000 tons of catalyst. On the first run it operated—*without shutdown*—over several times as long as the normal thermal cracking run. And to top this, it handled a catalyst loading—in grains per cu. ft.—*280 times as heavy* as is the general practice today!

This means that under present methods of catalyst plant loading and operation, MULTICLONE equipment has proven itself to have a life of *many* years. And when servicing *is* required MULTICLONE units offer the important advantage that the collector tube assembly can be quickly and easily removed by being lifted out through a convenient manhole *without dismantling the unit*. For interesting information on this and other vital MULTICLONE-COTTRELL advantages, send for booklet, "Catalyst Recovery."

HOW MUCH *IS* 25 MILLION TONS?

It is equivalent to the weight of concrete in the entire Grand Coulee Dam—*the largest man-made structure on earth!*

It is equivalent to the average weight of cargo passing through the Panama Canal in a *full year!* It is 3½ times the weight of concrete that went into building the Boulder Dam—*the highest dam in the world!*

In other words, it is a tremendous quantity. Yet this enormous amount of catalyst was handled in one year by a MULTICLONE Catalyst Recovery System.

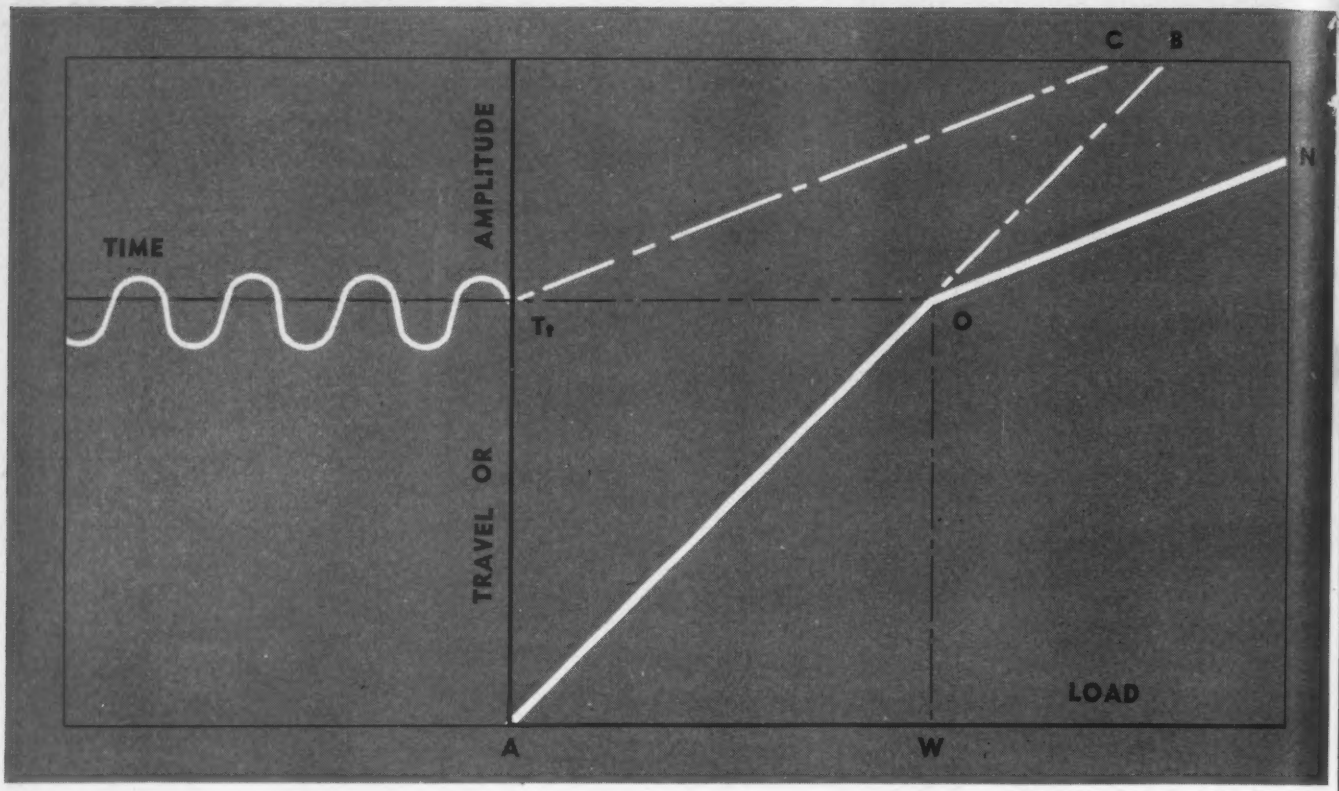
WESTERN Precipitation CORPORATION

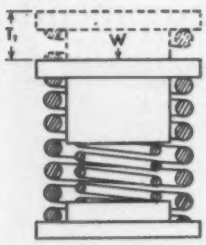
ENGINEERS, DESIGNERS AND MANUFACTURERS OF EQUIPMENT FOR COLLECTION OF SUSPENDED MATERIALS FROM GASES AND LIQUIDS

Main Offices: 1028 WEST NINTH STREET, LOS ANGELES 15, CALIF.
CHRYSLER BLDG., NEW YORK 17 • 140 S. DEARBORN ST., CHICAGO 3
HOBART BUILDING, SAN FRANCISCO 4, CALIF.

PRECIPITATION COMPANY OF CANADA, LTD. • DOMINION SQUARE BLDG., MONTREAL

NON-RESONANT



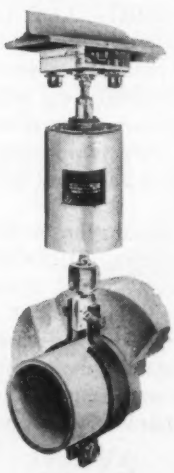


THE principle of the GENSPRING NR Hanger is based upon a parallel arrangement of two helical compression springs as shown in the view at left. The main or outer spring supports the entire weight of the pipe, W, and the inner or smaller spring functions only when vibration occurs. That is, after steam is turned on and a sufficient length of time allowed for the pipe line to come up to the operating temperature, the inner spring is brought into position by a suitable adjustment so that normally without vibration it is unloaded, but with the slightest vibration it is loaded intermittently every half cycle.

The graph of this arrangement is shown above in which line A-B is the load-deflection characteristic of the main or outer spring and line Tt—C is the load-deflection characteristic of the inner spring. Line A-O-N is the combined load-deflection characteristic of both springs. The bend or "knee" in the curve can, by means of the adjustment previously mentioned, be shifted to any position where the weight, W, comes to rest at the elevated temperature.

The purpose of the foregoing arrangement is to assure that the characteristic of any impressed vibration will straddle the "knee" so that half of the cycle occurs with a hanger stiffness factor and corresponding natural period of one value, and every alternate half cycle with a hanger stiffness factor and corresponding natural period of a different value. This prevents or greatly minimizes resonance because insufficient time is allowed for the resonant amplitude to develop. This is equivalent to employing time as a damping factor.

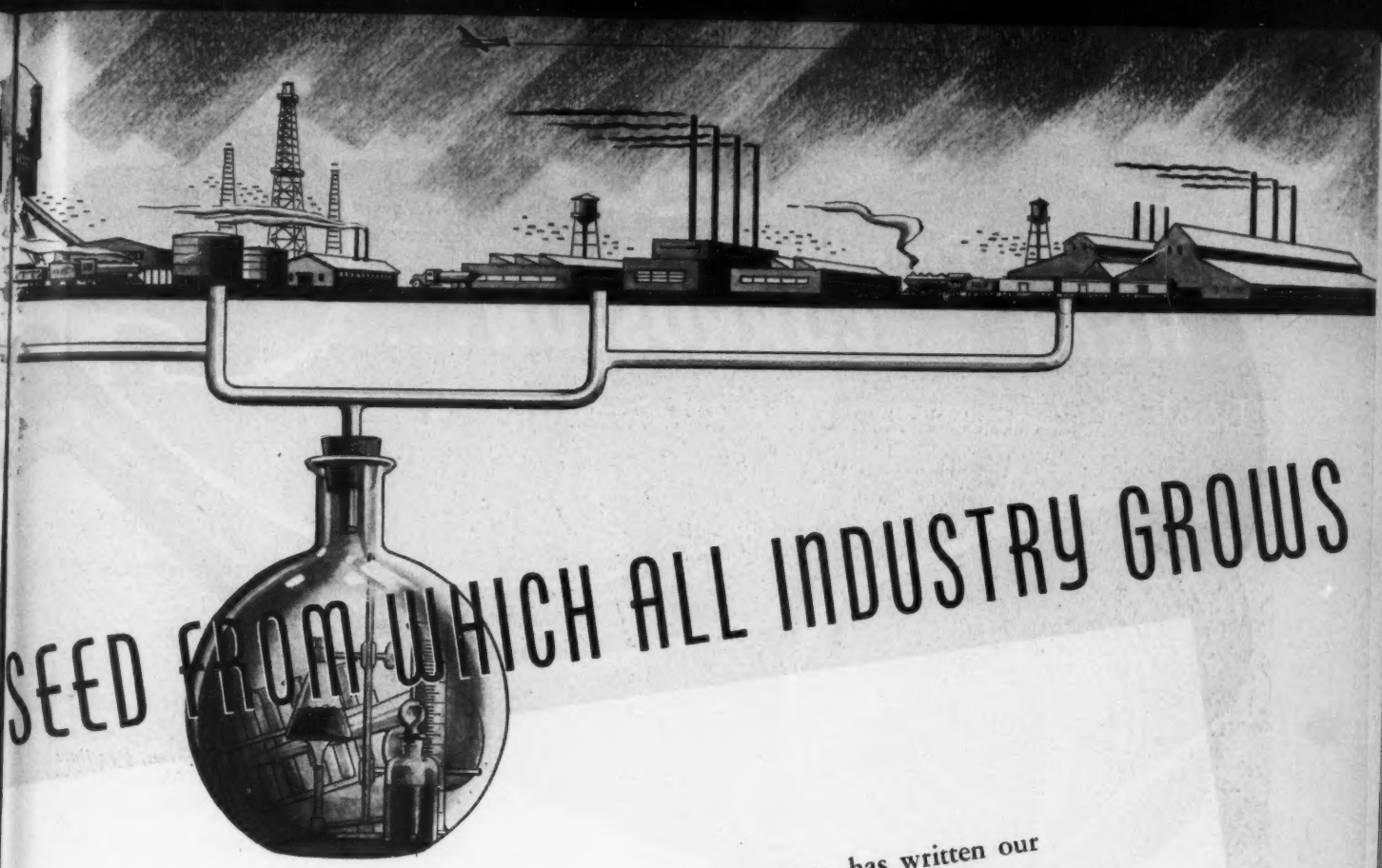
For application of this principle to your pipe-suspension problems, send for our Bulletin No. 101 which gives full particulars as to load ranges and sizes of units.



GENSPRING INC.
500 Fifth Ave. • New York 18, N. Y.

GENSPRING NR HANGER

NON-RESONANCE • LOW-HEADROOM • LATERAL FLEXIBILITY • DURABLE SPRING DESIGN • LOAD ADJUSTABILITY • LOW HEAT CONDUCTIVITY



SEED FROM WHICH ALL INDUSTRY GROWS

CHEMISTRY, the seed from which all industry grows, has written our world's history . . . It will record our future. Under the stimulus of war's insatiable demands for technical discovery and inventions, chemistry has revolutionized some of our basic industries. Most of these discoveries are common knowledge among normal rivals for the duration. But when the war ends, these new techniques will become the weapons of wide-open competition—under Free Private Enterprise.

The opportunity is definite. Products and processes, known or secret, are past the experimental stage. Research now aims at their development. This means planning and competent engineering. J. F. Pritchard & Company can help you.

J. F. Pritchard & Company engineers are experienced in the various unit operations of chemical engineering such as heat transfer, evaporation, distillation, gas absorption and extraction. These operations can be skillfully designed, from pilot plant through full scale operation. They can be coordinated to produce an efficient and flexible plant for the dehydration of gasses, production of alcohol, synthetics, processing of foods and the production of chemicals from petroleum.

J. F. PRITCHARD & COMPANY, *Chemical Division,* Fidelity Building
Kansas City, Missouri

KANSAS CITY
TULSA
CHICAGO

Pritchard

HOUSTON
NEW YORK
PITTSBURGH

ENGINEERS AND CONSTRUCTORS
FOR THE CHEMICAL • PETROLEUM • GAS AND POWER INDUSTRIES
Manufacturers of Mechanical and Atmospheric Cooling Towers

Equipment such as heat exchangers, pipe lines and heating coils stays on the job longer when made from this Stainless Tubing.

For positive protection against specific corrosive elements, and oxidation from high temperatures, it will pay you to learn more about this tubing.

In many plants, processes are completed faster because Carpenter Welded Stainless Tubing helps to reduce maintenance time. And because the inside surfaces are smooth, no tiny particles can lodge and give corrosion or product contamination a foothold. And this tubing is easy to clean, easy to keep clean.

For help with your special problems where corrosion and heat present processing difficulties, consider Carpenter as your general headquarters for useful information about Stainless Tubing. Much of our pioneering work and years of experience can probably be put to good use in solving your problems. Drop us a line today.

HERE'S WHY THIS STAINLESS TUBING IS EASY TO FABRICATE . . .

Uniform walls throughout mean that lighter gauges can be used without sacrificing strength. And *lighter gauges* permit savings in weight, as well as lower costs.

USE THIS PRINTED HELP TO GET THE MOST FROM THE STAINLESS TUBING YOU USE!

This convenient file folder provides some of the basic information you need when considering the use of Stainless Tubing. It gives data on corrosion resistance, physical properties of Carpenter Welded Stainless Tubing, sizes and shapes available, etc. A note on your company letterhead will start your copy on its way, so let us hear from you today.

THE CARPENTER STEEL COMPANY
Welded Alloy Tube Division • Kenilworth, N. J.

Carpenter
WELDED
STAINLESS TUBING

This is the 6TH *in a series of messages*

DEALING WITH THE PROBLEMS IN HEAT INSULATION FACED BY ENGINEERS AND SOLVED BY USING UNIBESTOS

6a THE PROBLEM

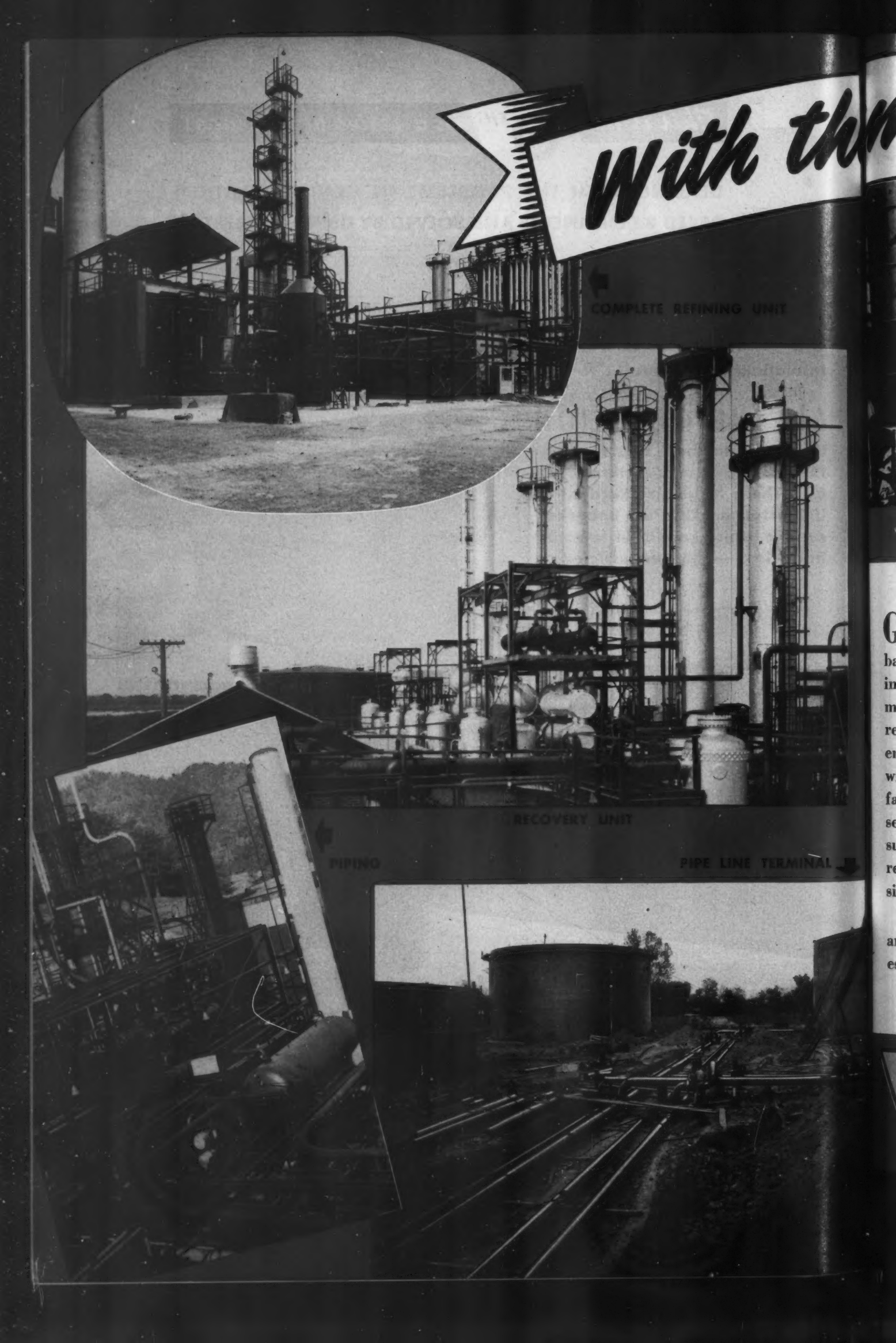
Insulating large pipes (12" to 60")

6b THE SOLUTION

Use Unibestos in ½ sections from 12" to 30" and in ¼ sections up to 60". These large size sections of Unibestos provide an unbroken surface which results in lowered heat loss — higher efficiency.

UNION ASBESTOS
MEANS PROGRESS IN INSULATION
AND RUBBER CO.

GENERAL OFFICES: 1821 S. 54th AVE., CICERO, ILL.
NEW YORK • SAN FRANCISCO • PATERSON, N. J.


With the
COMPLETE REFINING UNIT
RECOVERY UNIT
PIPING
PIPE LINE TERMINAL

Emphasis on SERVICE

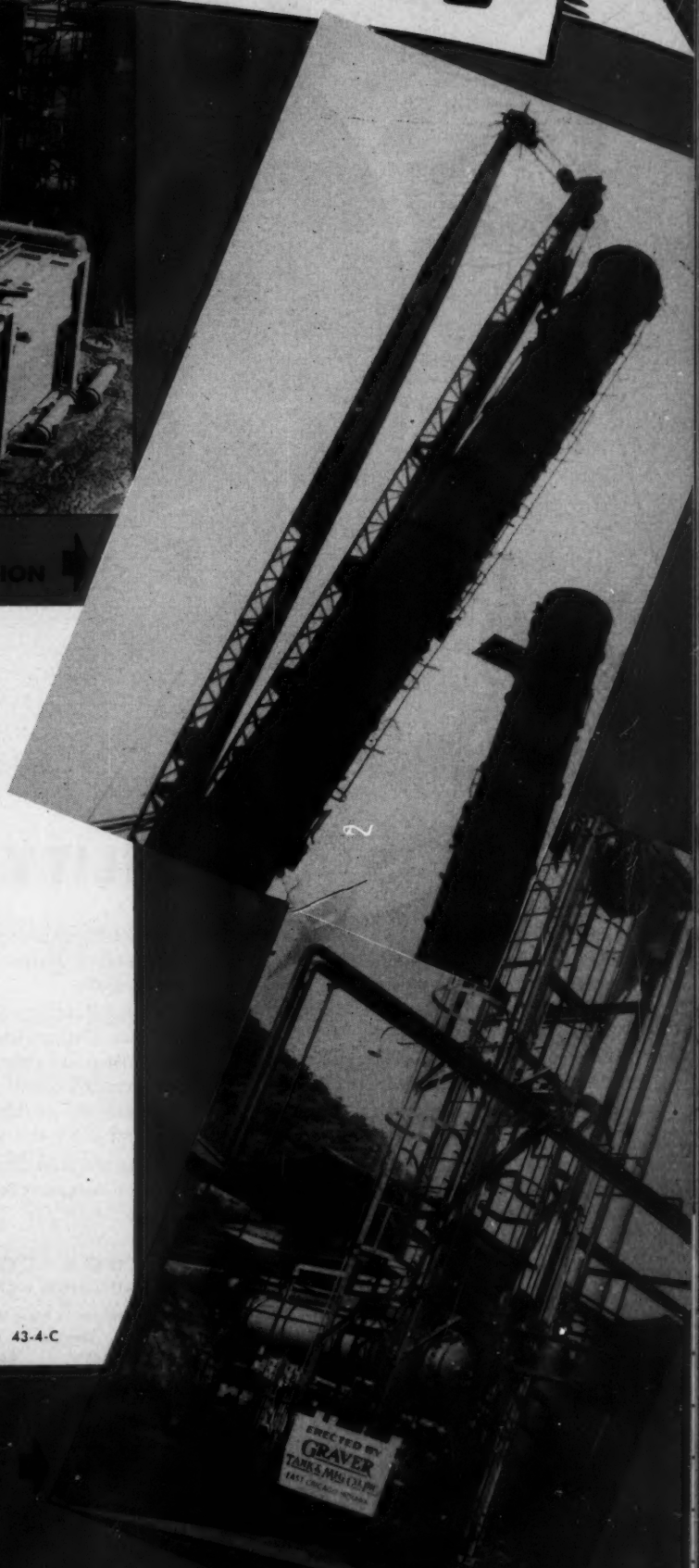
DISMANTLING

RE-ERECTION

GRAVER OFFERS to the Petroleum Industry a complete construction and erection service backed by an impressive record of achievement in the field. Trained personnel, modern equipment, and a thorough knowledge of the specific requirements of the industry combine to put the emphasis on SERVICE—the kind of service that will insure prompt completion—thorough satisfaction—and, on the part of the finished job, service for years to come. If desired, we can supply such steel plate equipment as may be required, fabricated by our manufacturing division to meet your most exacting specifications.

We shall be glad to discuss your construction and erection problems with you and submit cost estimates without obligation.

43-4-C



AUXILIARY

REFINING

EQUIPMENT

GRAVER

INDUSTRIAL CONSTRUCTION AND ERECTION

GRAVER TANK & MFG. CO., INC.

4809-65 Tod Avenue, East Chicago, Illinois

New York · Catasauqua, Pa. · Chicago · Tulsa

"FIRE POWER"—

IS A LIABILITY

"Fire Power" is a two-edged force. Applied by our weapons of war, it is driving the enemy nearer and nearer to complete defeat. Generated by combustibles in a vital war plant, "fire power" can cause crippling delays of war production in a dozen other plants.

Cardox Fire Extinguishing Systems are helping assure plenty of *effective* fire power for our fighting forces by guarding against *destructive* fire power in plants producing such critical war products as:

Airplanes, Airplane Parts, Armor Plate, Aviation Carburetors, Aviation Engines, Cold Strip Steel, Electric Power, Engine Parts, Forgings, Motor Fuel, Plastics, Processed Fabric, Rubber Products, Solvents, Tanks, Tank Engines.

An extremely wide variety of indoor and outdoor hazards—large or small—can be efficiently protected by individually engineered Cardox Fire Extinguishing Systems. By instant smothering of fire and cooling of combustibles through mass discharge of low pressure, low temperature carbon dioxide, they provide the all-important advantages of fast, complete extinguishment . . . *without damage to plant and equipment by the extinguishing medium.*

Today Cardox is concentrating on (1) Fire Extinguishing Systems needed to insure more effective "fire power" for our Armed Forces; (2) plans to increase the efficiency of fire protection, both today and after the war.

If you would like more information, write on company letterhead for Bulletin 24123.

CARDOX CORPORATION
BELL BUILDING • CHICAGO 1, ILLINOIS

District Offices in **New York • Washington Detroit • Cleveland • Atlanta • Pittsburgh San Francisco • Los Angeles • Seattle**

How Cardox Systems Protect War Industries

- Timed discharges, as needed, through built-in piping systems . . . supplied instantly from a single storage unit holding tons (if required) of liquid Cardox CO_2.
- Mass discharge of Cardox CO_2 "knocks out" fire, by . . .
- Reducing oxygen content of the atmosphere below the concentration necessary for combustion, and . . .
- Cooling combustibles and fire zone below ignition temperature . . .
- Extinguishing fire quickly and completely *without* damage from extinguishing medium.

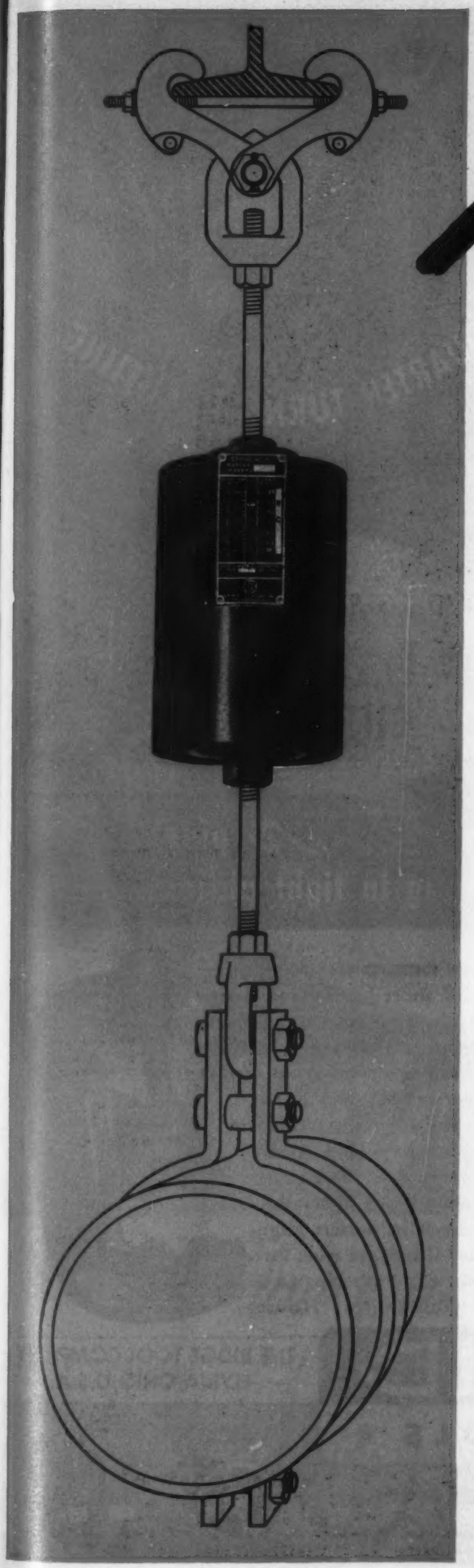
CARDOX—CO_2 Systems with Enhanced Fire Extinguishing Performance

A. Uniformity of CO_2 characteristics.
B. Extinguishing medium with uniformly greater cooling effect.
C. Accurate projection of CO_2 through greater distances.
D. Timed discharges, as needed, through built-in piping systems . . . supplied quickly from a single tank holding tons of liquid Cardox CO_2.

ENHANCED COOLING EFFECT
CENTRAL STORAGE UNIT
AMPLE CO_2 RESERVE
ENGINEERED SYSTEMS
AUTOMATIC

CARDOX

NON-DAMAGING FIRE EXTINGUISHING SYSTEMS



New!

GRINNELL
Pre-Engineered
SPRING HANGERS

14 Sizes with a Load Range from 84 lbs. to 4700 lbs.

Piping engineers who have struggled with the design of simple spring hangers to support modern flexibly supported piping systems will welcome this new Grinnell Spring Hanger. It is now possible to select a stock size of hanger from a simple table after the load has been computed.

MINIMIZES CHANGES IN PIPE SUPPORTING FORCE

ALL-STEEL WELDED CONSTRUCTION MEETS PRESSURE PIPING CODE

UNIQUE SWIVEL COUPLING PROVIDES ADJUSTMENT AND ELIMINATES TURNBUCKLE

COMPACT—REQUIRES MINIMUM HEADROOM

INSTALLATION IS SIMPLIFIED BY INTEGRAL LOAD SCALE AND TRAVEL INDICATOR

14 SIZES AVAILABLE FROM STOCK

EASY SELECTION OF PROPER SIZE FROM SIMPLE CAPACITY TABLE

You will want complete details and engineering data on this new Pre-Engineered Spring Hanger Fig. 268. Write for copies of the descriptive folder. Grinnell Company, Inc., Executive Offices, Providence, R. I. Branch Offices in principal cities.

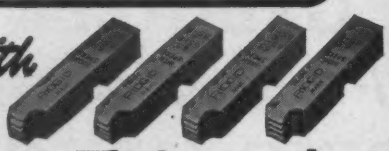
GRINNELL

WHENEVER *Piping* IS INVOLVED

Perfect Threads

on 4 sizes of pipe

with



1 set of chaser dies

And this RIDGID No. 65R gives you almost automatic workholder and chaser die setting

NO MORE playing tiddly-winks with 16 chaser dies when you want to thread 1", 1¼", 1½" or 2" pipe. Grab your RIDGID No. 65R, trim, efficient, self-contained — set mistake-proof workholder to pipe size instantly (no bushings!), set chaser dies in 10 seconds — you're ready to thread! Feather-light pull cuts smooth perfect threads, any variation, any pipe. High-speed steel dies, rugged steel-and-malleable construction. For better faster threading . . . see it at your Supply House today.

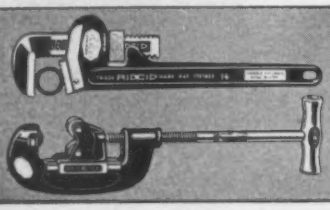
THIS new RIDGID trench-type cutter, with short handle and 4 cutting wheels, goes into tight places and cuts pipe that regular cutters won't touch — all you need is room for a quarter turn. But it cuts any pipe anywhere much faster, so you get time-saving service from it every day. Tough malleable frame holds heavy-duty cutter wheels in perfect alignment, they always cut true. Two sizes: No. 42 to 2", No. 44 to 4" — at your Supply House.

Buy RIDGID Pipe Tools at Supply Houses Everywhere

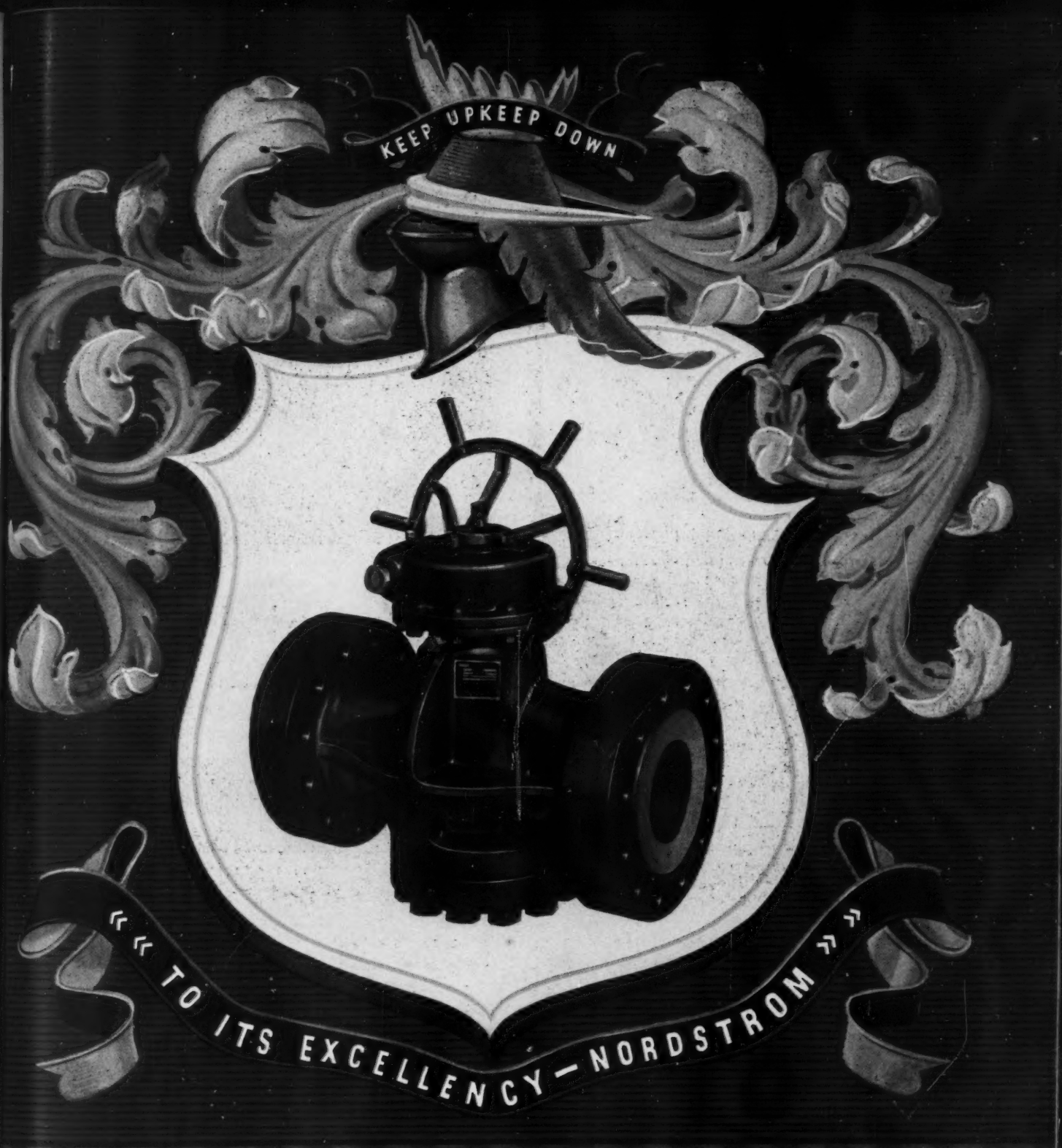
RIDGID

★ PIPE TOOLS ★

THE RIDGE TOOL COMPANY
ELYRIA, OHIO, U.S.A.



Fast-Working Tools for War . . . and the Busy Peace that's Coming



FIRST *Choice in Critical Industries*

FIRST *choice for controlling vital flow lines in U.S. Government fuel dumps.*

FIRST *choice for drastic line service in synthetic rubber producing plants.*

FIRST *choice for conquering abrasion in mud lines for rotary oil well drilling.*

FIRST *choice in chemical plants for handling corrosive and erosive liquids and slurries.*

FIRST *choice in petroleum refineries for handling high temperature hydrocarbons.*

FIRST *choice on pipe lines for complete safety in handling oil, gas and gasoline.*

Nordstrom

LUBRICATED VALVES

Sealdport Lubrication

MERCO NORDSTROM VALVE COMPANY — *A Subsidiary of Pittsburgh Equitable Meter Company*

WORLD'S LARGEST MANUFACTURERS OF LUBRICATED PLUG VALVES; GASOLINE, OIL & GREASE METERS

Main Offices: 400 Lexington Ave., Pittsburgh, Penna. • *Oakland (Calif.) Factory:* 2431 Peralta St.

BRANCHES: Buffalo, Chicago, Columbia, Des Moines, Houston, Kansas City, Los Angeles, Memphis, New York City, Oakland, San Francisco, Seattle, Tulsa

CANADIAN Licensees: Peacock Bros., Ltd., Montreal • *EUROPEAN Licensees:* Audley Engineering Co., Ltd., Newport, Shropshire, Eng.

SOUTH AMERICAN Representative: The Armco International Corporation. *Main Office:* Middletown, Ohio

PRODUCTS: Nordstrom Lubricated Valves; Air, Curb and Meter Cocks • Nordco Valve Lubricants • EMCO Gas Meters • EMCO-McGaughy Integrators • EMCO Regulators • Pittsburgh-National Meters for Gasoline, Grease, Oil, Water and other Liquids • Stupakoff Bottom Hole Gauges

THEY GAVE AMERICA A "FLYING START"

The following companies are operating or have under construction

59 HOUDRY AND T.C.C. UNITS

ASHLAND OIL & REFINING COMPANY
CONTINENTAL OIL COMPANY
CROWN CENTRAL PETROLEUM CORP.
GENERAL PETROLEUM CORP. OF CALIFORNIA
GULF OIL CORPORATION
MAGNOLIA PETROLEUM COMPANY
THE PURE OIL COMPANY
RICHFIELD OIL CORP.
SINCLAIR REFINING COMPANY
SOCONY-VACUUM OIL COMPANY, INC.
SOUTHPORT PETROLEUM CO.
STANDARD OIL CO. OF CALIFORNIA
STANDARD OIL CO. (OHIO)
SUN OIL COMPANY
TIDE WATER ASSOCIATED OIL COMPANY
UNION OIL CO. OF CALIFORNIA

There has been no greater contribution to the war effort than catalytic cracking

AS we near the second anniversary of America's declaration of war, we may well give due credit to the five leading oil companies which were first to adopt the Houdry Catalytic Cracking Process.

Whether by fate or foresight, they were ready. The day the dreadful news of Pearl Harbor broke upon an unsuspecting and unready America, these five companies—Socony-Vacuum, Sun, Magnolia, Tide Water Associated and Standard of California—had 14 Houdry catalytic cracking units in operation and two more nearing completion. Within a few months, most of these facilities had been converted to the manufacture of this war's most critical material, high octane aviation gas.

These pioneers of catalytic cracking soon were joined by other leading petroleum refiners. Sixteen companies are now operating or building Houdry and T. C. C. units. They include many of the industry's best known names and represent more than 50% of total U. S. refining capacity.

During two critical years of a war whose issues have been mainly decided in the air, Houdry licensees have carried almost the entire load of producing catalytically cracked aviation gas for the United Nations. Today, 23 out of the 27 catalytic cracking units in operation are Houdry-licensed units. Thirty-six more Houdry and T. C. C. units are being built.

Houdry Catalytic Processes and the Thermofor Catalytic Cracking Process are available to all American refiners, under license arrangements, subject to approval by the United States Government.

HOUDRY CATALYTIC PROCESSES
... FOR VICTORY IN WAR
... FOR PROGRESS IN PEACE

HOUDRY PROCESS CORPORATION, WILMINGTON, DELAWARE

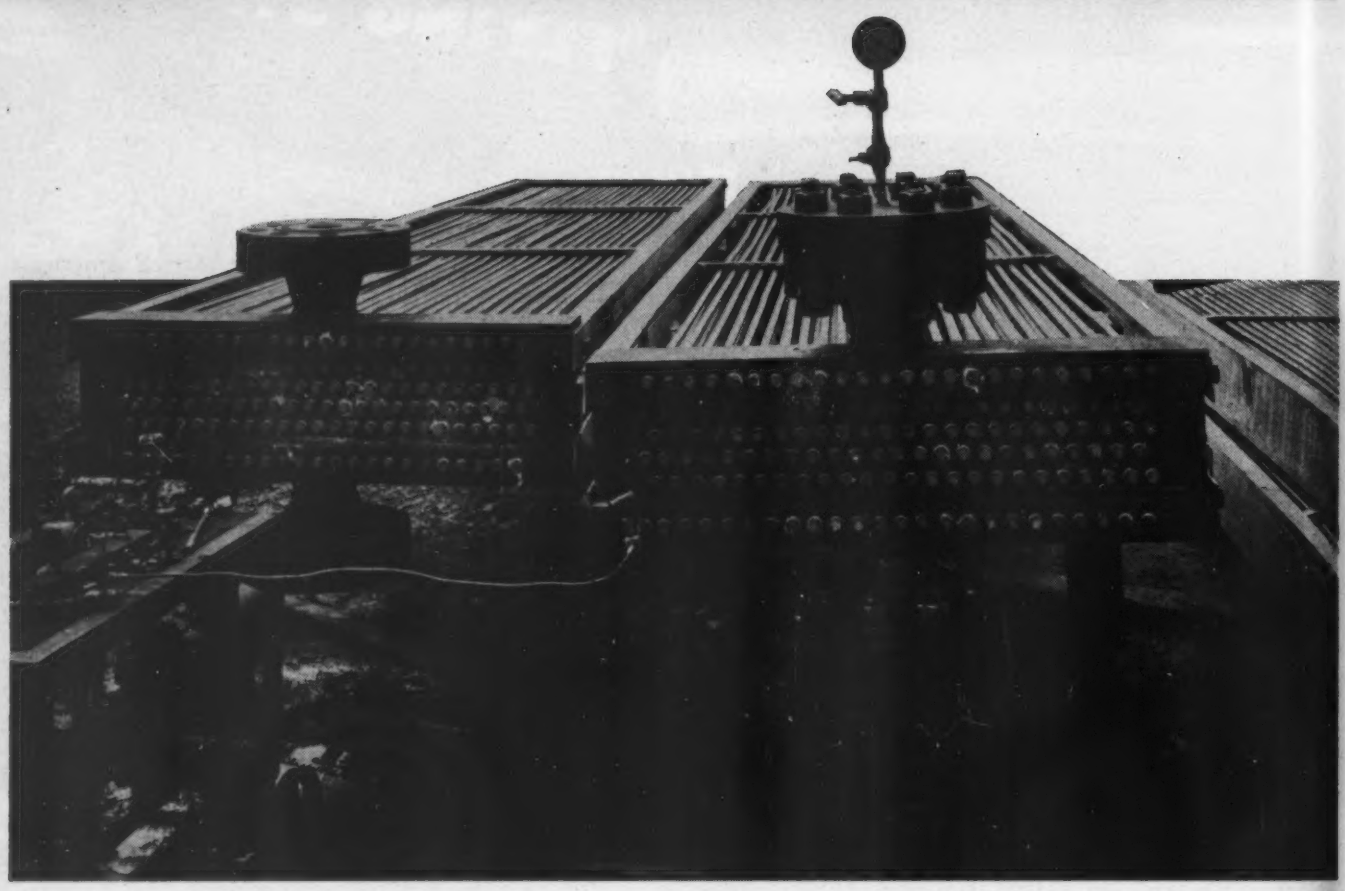
Licensing Agents:—

E. B. BADGER & SONS CO.
Boston, Massachusetts

BECHTEL-McCONE-PARSONS CORP.
Los Angeles, California

THE LUMMUS COMPANY
New York City, New York

"COYNCO"



for HIGH PRESSURES

A new "Coynco" ATMOSPHERIC SECTION design, for unusually High Pressure service. This illustration shows two of the three "Coynco" Gas Cooling Sections recently built for 4,000 pounds working pressure. Installations will be in a new plant supplying aviation gasoline charge stock. Rugged construction assured by fabrication from steel plate.

All the latest developments in Shell and Tube, Submerged and Atmospheric practice, in keeping with the WPB Standards, are assured our customers. We invite your inquiries concerning specialized items for the processing divisions of the petroleum industry.

Joseph A. Coy Co., Inc.

3515 Dawson Road Phone 3-9196

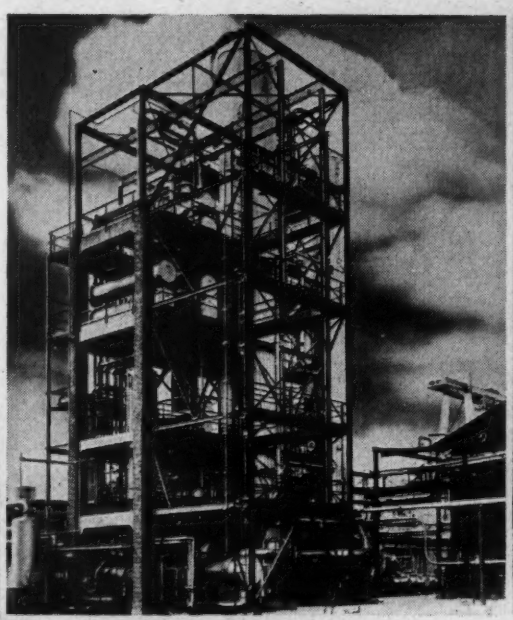
TULSA, OKLAHOMA

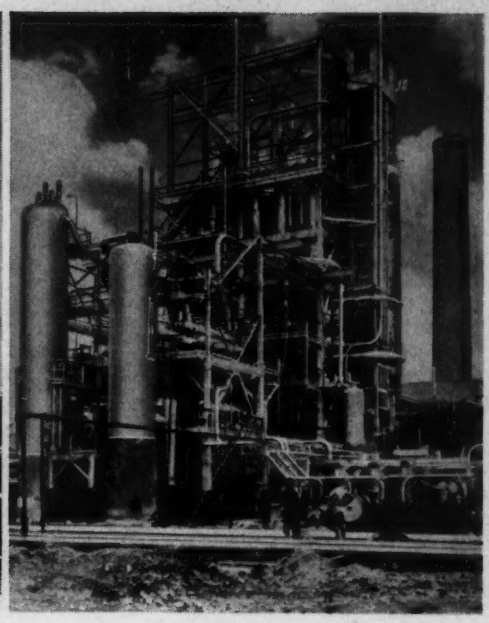
One Answer to the Costly Corrosion Problem

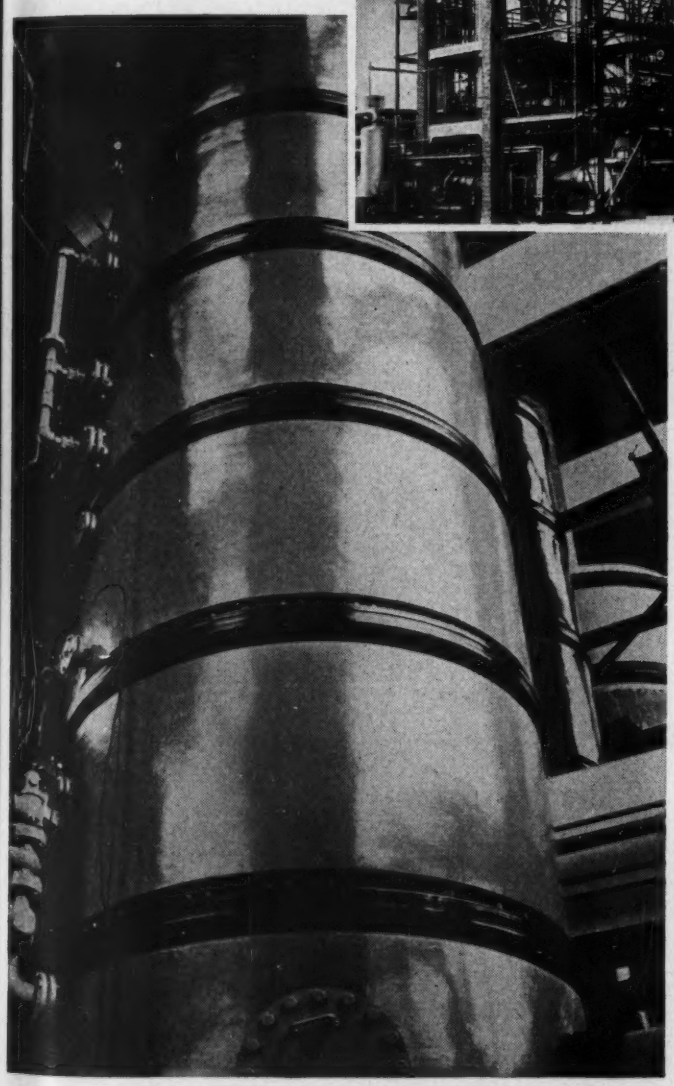
Stainless steel cracking tubes for this refinery unit (near right) resist corrosion, embrittlement, and creep at high temperatures. (Courtesy, The Lummus Co.)

•

Bubble tower (far right) for producing high octane gasoline is lined with 12 to 14 per cent chromium steel to resist hydrogen sulphide corrosion. (Courtesy, The Lummus Co.)







Distillation columns of stainless steel used in the synthetic rubber industry resist the corrosive effect of chemicals and also insure the purity of the chemicals for the synthesis of rubber.

LABORATORY and field tests show that in general the corrosion resistance of steel equipment increases with increasing chromium content.

Stainless steels contain at least 12 per cent chromium. These withstand corrosion from brackish condenser water, and from hot petroleum products that contain sulphur compounds. They resist oxidation by furnace gases, even when under heavy stress. They retain high strength at elevated temperatures. They are wear-resistant.

Because of these properties stainless steels have many applications in the petroleum industry: in tubes of heat exchangers; in high-temperature air preheaters on stills; in flue-gas recirculation systems; in systems removing hydrogen sulphide and mercaptans; in pumps, liners, orifice plates, thermocouple wells, baffles; in furnace tubes and dampers.

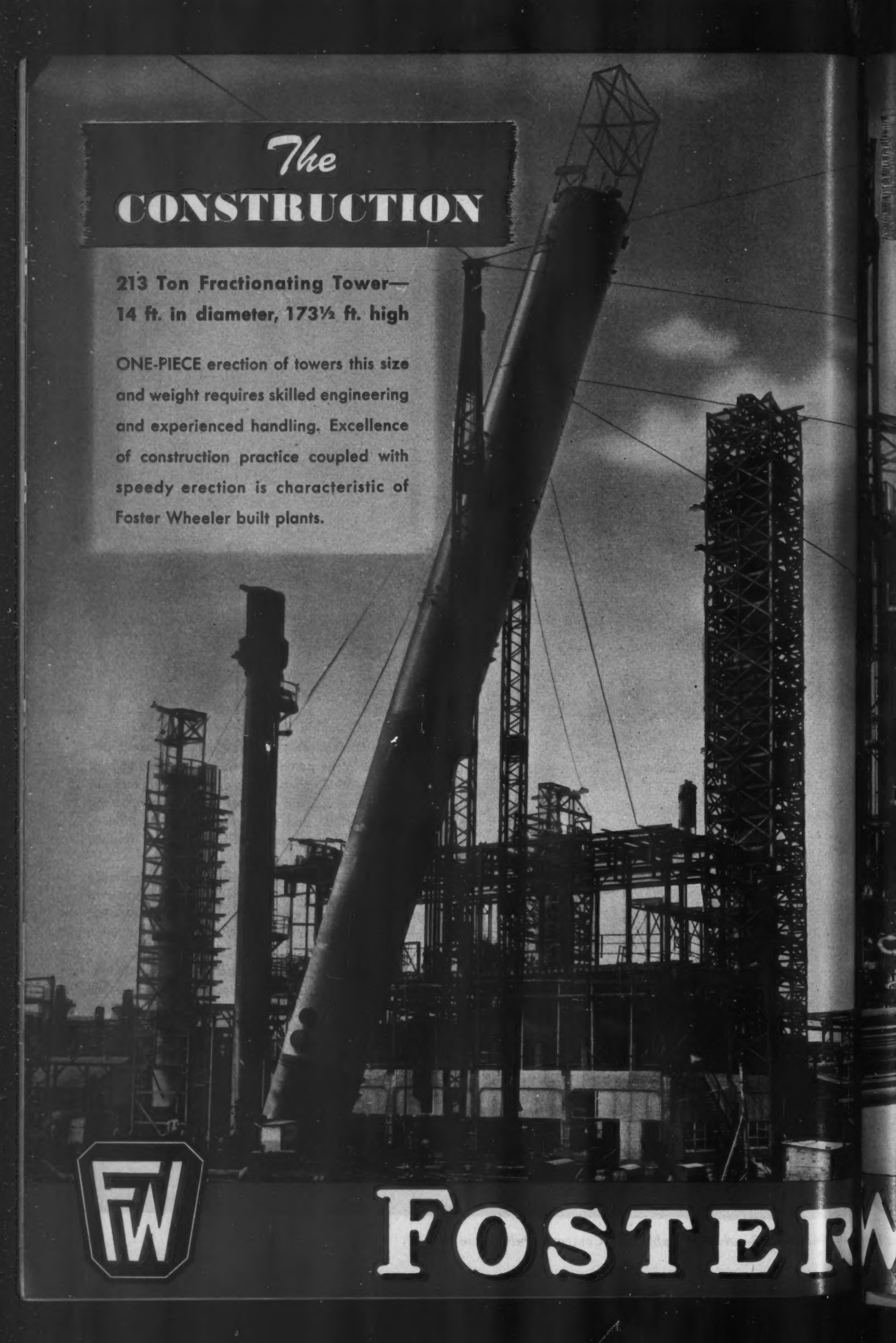
Corrosion resistance—heat resistance—wear resistance—these advantages of stainless steels, so important to petroleum equipment, can be utilized in many other fields. Stainless steels have a unique service record in the tough jobs of industry.

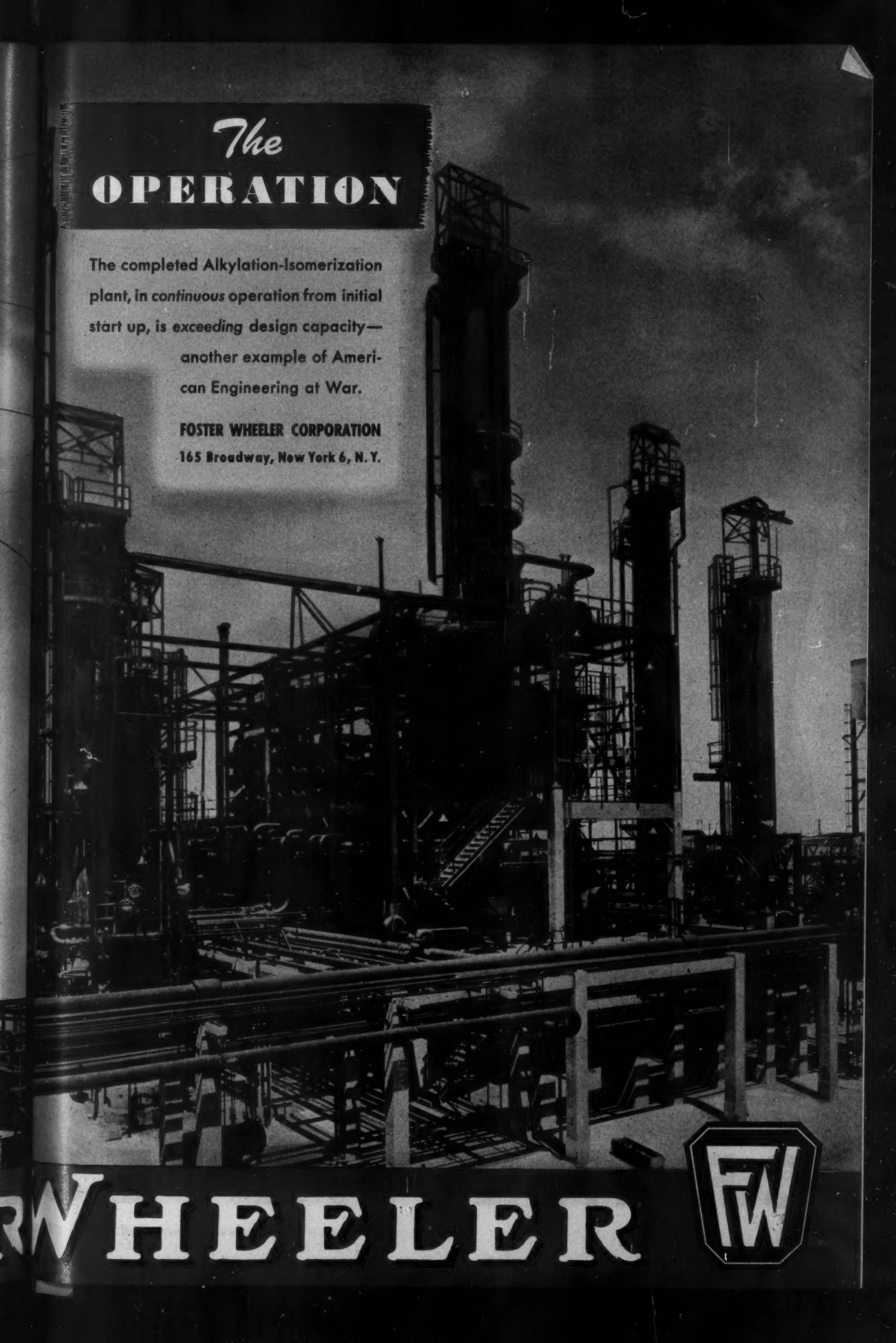
We do not make stainless steel, but we do make ferro-chromium—the backbone of stainless steel. For more than 35 years our metallurgists have studied ferro-alloys and alloy steels in the laboratory and in the field. If you have a question on the selection or use of stainless steel, consult us.

BUY UNITED STATES WAR BONDS AND STAMPS

ELECTRO METALLURGICAL COMPANY
Unit of Union Carbide and Carbon Corporation
30 East 42nd Street UCC New York 17, N. Y.
In Canada: Electro Metallurgical Company of Canada, Limited, Welland, Ontario

Electromet
Trade-Mark
Ferro-Alloys & Metals


The
CONSTRUCTION
213 Ton Fractionating Tower—
14 ft. in diameter, 173½ ft. high
ONE-PIECE erection of towers this size and weight requires skilled engineering and experienced handling. Excellence of construction practice coupled with speedy erection is characteristic of Foster Wheeler built plants.
FW
FOSTER


The
OPERATION
The completed Alkylation-Isomerization plant, in *continuous* operation from initial start up, is *exceeding* design capacity—another example of American Engineering at War.
FOSTER WHEELER CORPORATION
165 Broadway, New York 6, N. Y.
WHEELER
FW

Ready Now!

NEW TRAINING AIDS FOR PIPING MEN

❶ "PIPING POINTERS" SOUND FILM

❷ "PIPING POINTERS" MANUAL

FACTS ABOUT THESE NEW CRANE SERVICES

The "Piping Pointers" film is 16 mm. size with sound track. Approximate showing time, 30 minutes. Available free for showing in any plant, trade school, or industrial training center. The "Piping Pointers" manual is supplied free for all viewers of the film.

ARE your piping maintenance trainees learning fast enough to replace skilled men gone to war? Can they assure your plant of dependable piping service while replacement materials are far from plentiful?

Training of workers is made faster and doubly effective by these new Crane "Piping Pointers" services. Each complements the other in teaching the fundamentals of piping and proper care of valves and fittings to keep up pipe-line efficiency.

The "Piping Pointers" Manual is the most complete service of its type ever compiled, its chapters ranging from "The Language of Piping" to "Playing Safe on the Job." In the film, trainees see and hear how the manual's content is actually applied.

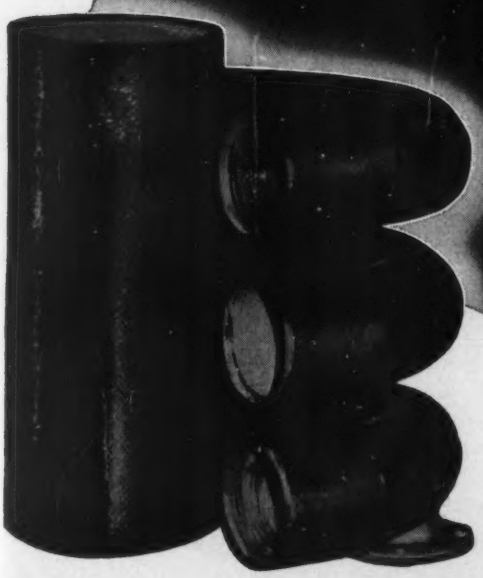
Available Free to Any Plant

Full information about these services and suggestions for using them most profitably are available on request from your local Crane Representative. Consult him regarding manuals for your piping crews, and showings of the "Piping Pointers" film in your plant.

Crane Co., General Offices: 836 S. Michigan Ave., Chicago 5, Ill.

CRANE VALVES

IF IT'S PIPING CONTACT FLORI



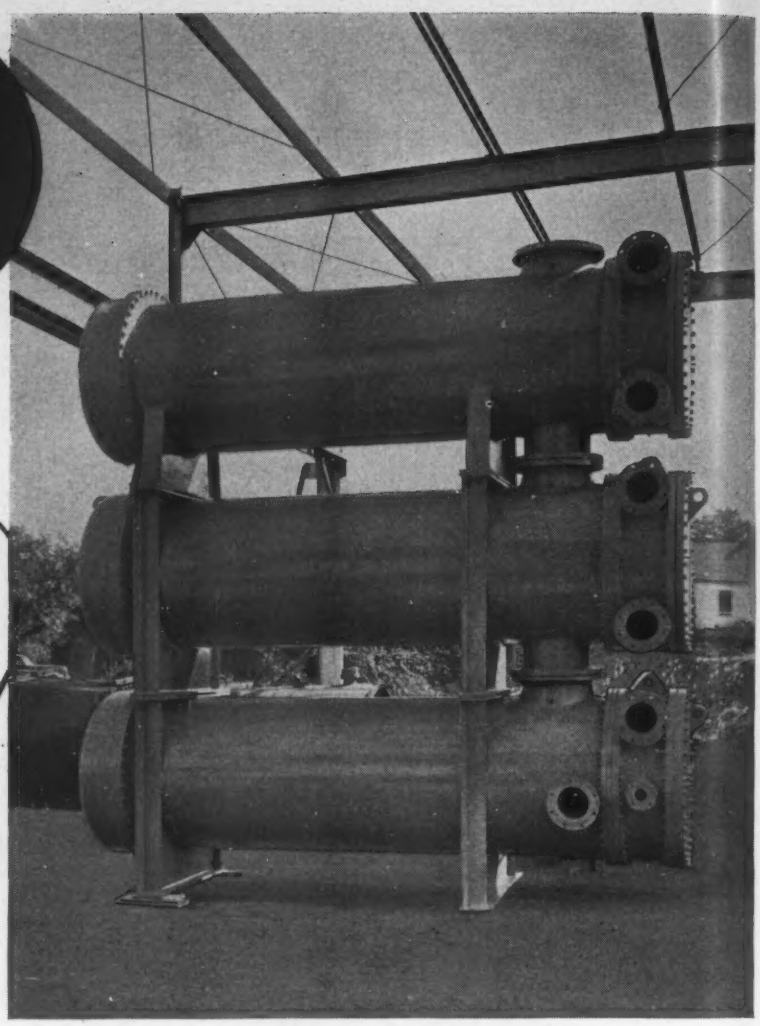
We make anything in tubular or plate steel fabrication: Fabricated Piping —for steam, water, air, oil, gas, chemicals • Random mill or cut lengths, bent, coiled, welded, flanged, threaded • Valves, Pipe Fittings.

Send us your inquiries.

FLORI PIPING

THE FLORI PIPE COMPANY • ST. LOUIS—CHICAGO

Typifying
PATTERSON-KELLEY
Service and Products



"Tailor Made"
THREE-STAGE STACK HEAT EXCHANGER

Design statistics include: straight tube; floating-head with split backing ring; removable heating section. Steel shell, tube heads, channels and covers; Admiralty tubing.

Equipment that is "tailor made" is never delivered immediately... even in normal times. It's not shelf goods. But even today, under the stress of wartime scarcities of labor and materials, we are able to turn out special jobs in exceptionally fast time.

At Patterson-Kelley there are three factors that make this possible:

1 ... Highly trained engineers with a specialized background to enable them to solve your particular problem.

2 ... Old hands in the shop who have, for years, been constructing all types of heat transfer and pressure vessels. They know the specialized techniques and materials used in the field.

3 ... 63 years experience in design, construction and installation of specialized heating equipment.

This illustration shows one of these fast jobs. It's a Patterson-Kelley Type E 3 Stage Stack Heat Exchanger, built to special order like so many Patterson-Kelley products. It solved a refinery's heat-transfer problem. If there is a heat-transfer problem in your plant, why not write or call us? We can give it immediate attention.

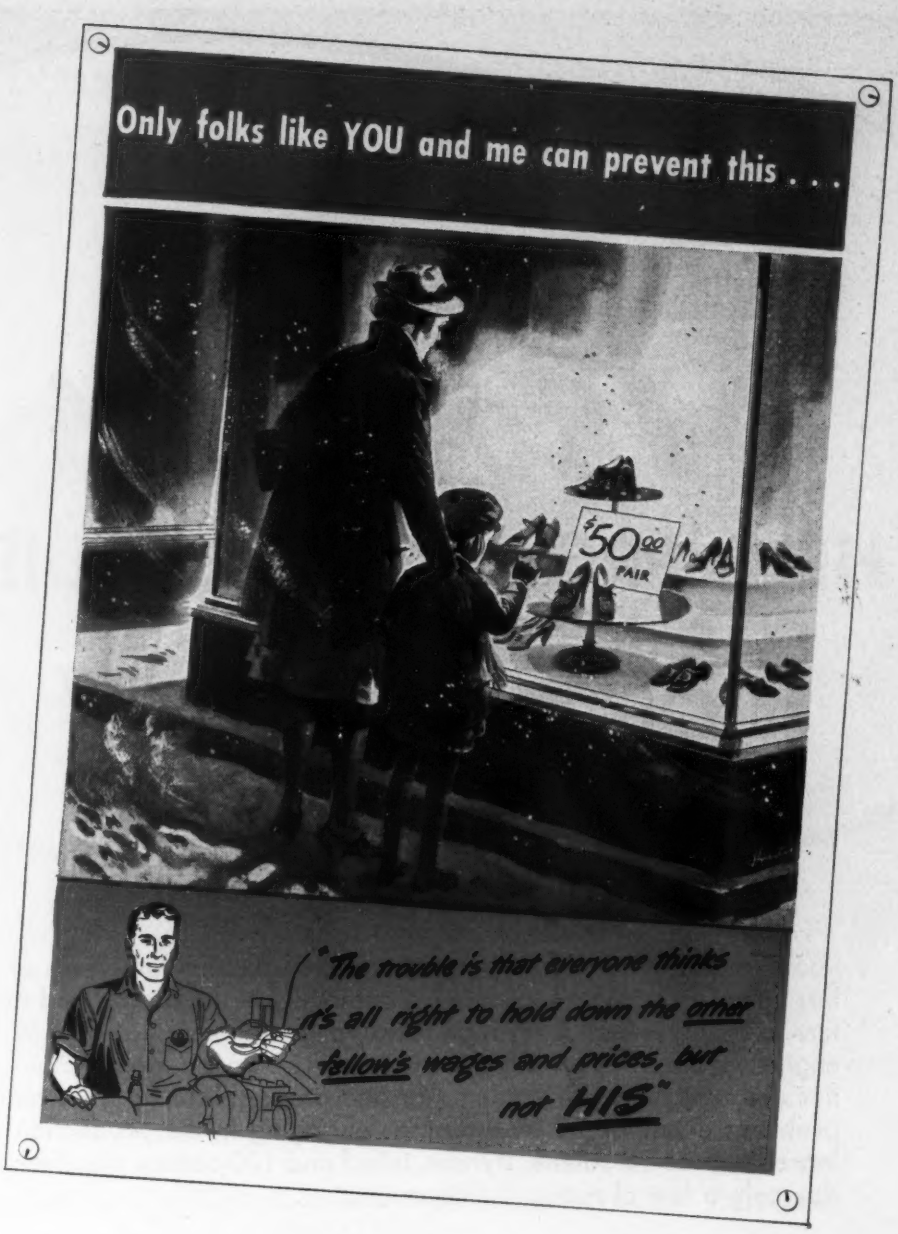
EST. 1880

THE PATTERSON-KELLEY Company, Inc.

Main Office and Factory 113 WARREN STREET, EAST STROUDSBURG, PA.

BOSTON 16, 96-A Huntington Avenue • NEW YORK 17, 101 Park Avenue • PHILADELPHIA 3, 1700 Walnut Street • CHICAGO 4, Railway Exchange Building

12-PK-3


Only folks like YOU and me can prevent this . . .
$50.00 PAIR
"The trouble is that everyone thinks it's all right to hold down the other fellow's wages and prices, but not HIS"

Put up this poster in your plants or offices

Our Government is engaged in another desperate war right now . . . the war against rising costs, climbing wages, spiraling prices. It is fighting to prevent runaway prices *now* and to prevent the depression which would surely follow.

Much of our Government's planning . . . many of the functions of whole departments . . . many current "campaigns" . . . are all tied into this.

That's why we have the OPA and ceiling prices. That's why we have roll-backs. That's one reason we have War Bond campaigns. That's why we have salary, wage and rent freezes. That's one of the reasons for boosting taxes. That's why we have restrictions on installment selling.

The greatest weakness in the fight against inflation is that everyone thinks it's all right to hold down the other fellow's wages and prices, but not his.

Will *you* help in this fight? It's your battle.

If you would like to help this fight by displaying this poster, use the coupon below for free copies.—Koppers Company and Affiliates, Koppers Bldg., Pittsburgh, Pa.

KOPPERS

THE INDUSTRY THAT SERVES ALL INDUSTRY

Please send me_____copies of your High-cost-of-living poster.

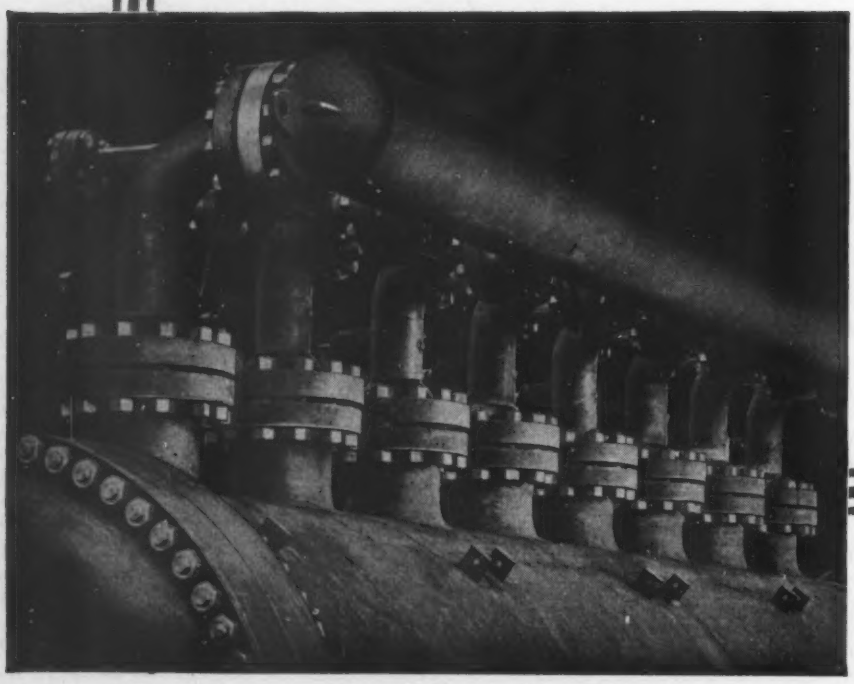
YOUR NAME_____ TITLE_____

COMPANY_____

ADDRESS_____

B&W Products HELP PRODUCE INGREDIENTS OF Victory

The tremendous progress made by the Process Industries in the past few years in producing what are now proving to be the Ingredients of Victory has called for much ingenuity and originality in the design and manufacture of high-temperature, high-pressure equipment. Babcock & Wilcox engineers, aided by greatly expanded and improved manufacturing facilities are constantly developing new and practical solutions for many such problems encountered by industries engaging in the production of such Ingredients as butadiene, styrene, toluol and 100-octane gasoline, to mention only a few of many developments.



Reaction chambers with Collecting Headers designed and manufactured for oil refinery. Overall chambers—5 ft. O. D. x 1 in.—2 in. x 28 ft. 5⅛ in.

Pushout connection welded in 66-inch diameter shell. Design working pressure 1475 psi. Pushout made of 6¼ inch plate.

B&W EQUIPMENT PRODUCING THE INGREDIENTS OF VICTORY INCLUDES:

Pressure vessels for processes producing butadiene, toluol and high-octane gasoline;

Catalyst cases for production of butadiene from alcohol and butane;

Separately-fired high-temperature and high-pressure superheaters for butadiene production;

Alloy furnace castings for all processes.

Production of such equipment represents a major activity at B&W, where an outline of *your* problem will be welcomed.

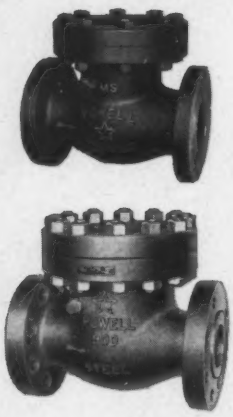
THE BABCOCK & WILCOX CO.

85 LIBERTY STREET
NEW YORK 6, N. Y.

B-437

Ask POWELL for the Answer to all your VALVE requirements

Ask POWELL for the Answer to all your VALVE requirements
THE WM. POWELL CO.
Dependable Valves Since 1846
CINCINNATI 22, OHIO



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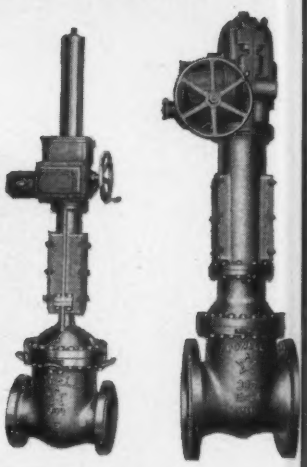
CINCINNATI 22, OHIO



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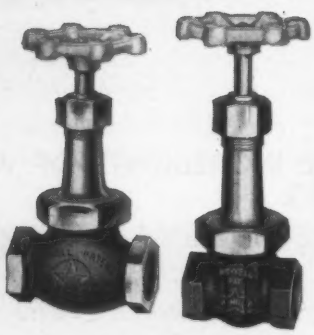

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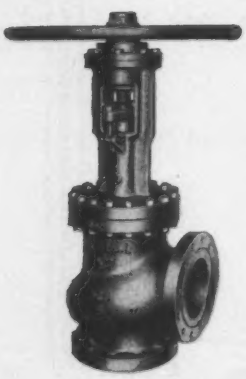

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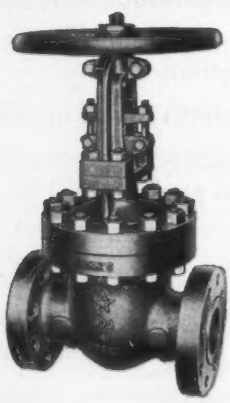

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● This man thought he was doing his duty when he ran for an extinguisher and turned it on a little fire. But nobody had told him that different classes of fire call for different fire-fighting methods. So he used a good extinguisher against the wrong fire—and the blaze soon got out of hand.

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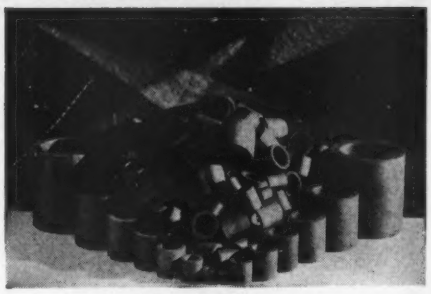
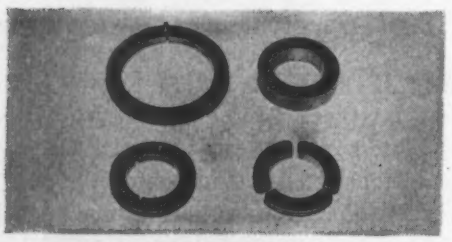
- ✓ Caustic removal of Hydrogen Sulphide for which Carbon Raschig Rings have long been preferred.

"National" and "Karbate" carbon and graphite materials possess the following important characteristics. Consider these characteristics when designing new equipment or when seeking greater economy and efficiency from existing equipment.

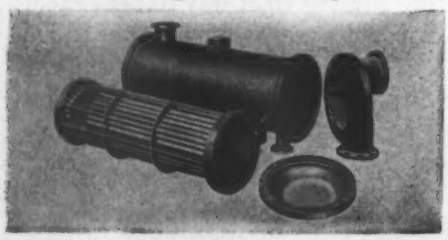


Raschig Rings

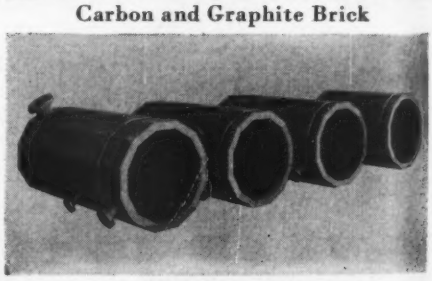


Packing and Seal Rings

Carbon and Graphite Brick



Tube and Shell Heat Exchanger



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- High thermal conductivity for heat exchange or dissipation (graphite and graphite base "Karbate" units)
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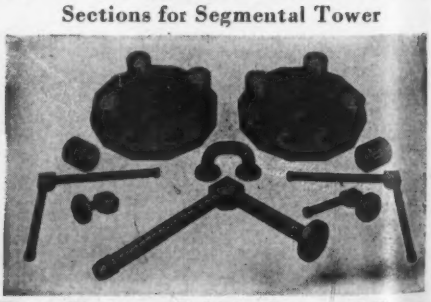

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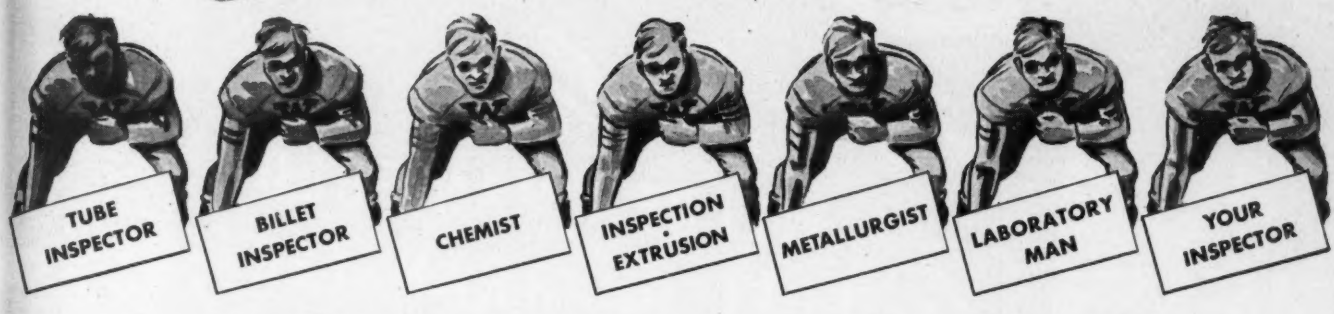
No defective billet can crash this line



. . . that's why you can always depend on the uniform high quality of

WOLVERINE condenser tubes

Here's a line of real All-American caliber—a line that presents an impregnable defense to any defective condenser tube billet.

We call your particular attention to the center position, the Wolverine Inspection-*before*-Extrusion process. This player was developed by Wolverine, and is one of the most important members of the team. He plays in every game, every year.

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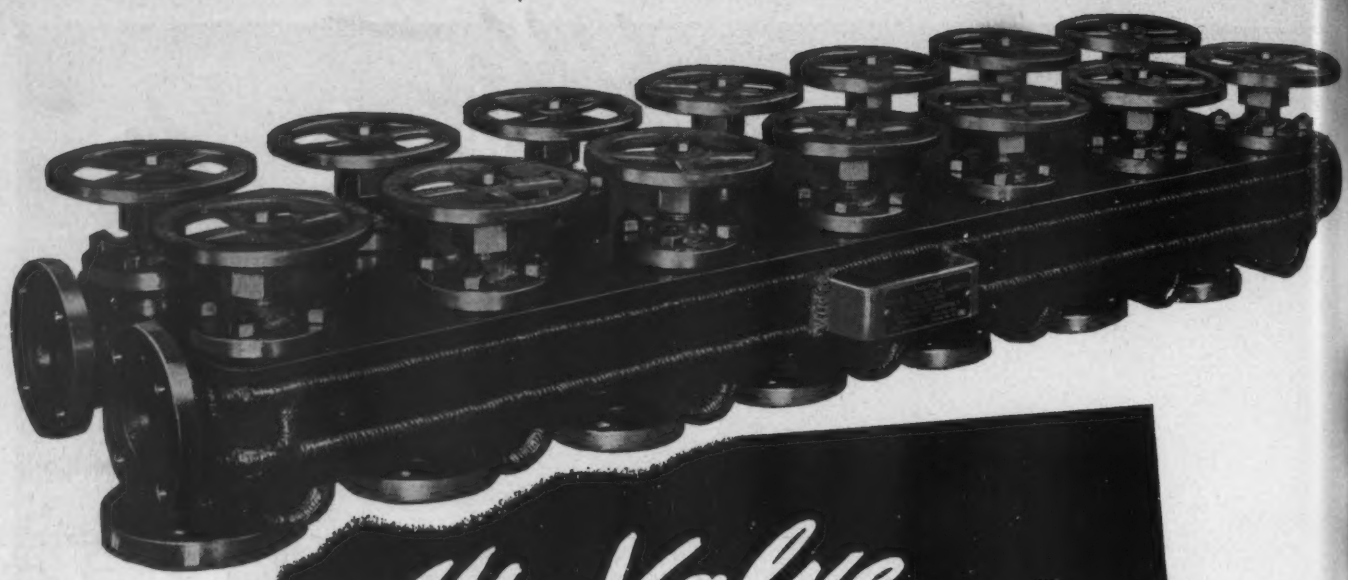

14-Valve . . . WELDED MANIFOLD for FUEL OIL TRANSFER

Shown above is a 2-inch valve welded manifold for transfer of fuel oil between storage tanks. Designed for a working pressure of 150 lbs. and tested to 500 lbs. this unit provides a compactness and freedom from maintenance common to all *"Code-Craft"* manifolds.

There is practically no limit to the combinations of valve arrangements possible in *"Code-Craft"* welded construction. Any number of valves of any type and in any size, in single and double manifolds, of carbon and stainless steel, chrome iron, nickel, Monel and other alloys, can be combined in an integrated unit to meet any requirements in liquid, steam or vapor service. Advantages of *"Code-Craft"* Welded Valve Manifolds include: greater strength with less weight; elimination of bolts, gaskets and flanged fittings between valves; substantial savings in insulation costs; elimination of patterns and leaky castings; minimum pressure drop.

We welcome inquiries from engineers in the Petroleum and Petro-chemical industries. Send us your drawings or specifications for prompt quotations.

OTHER *"Code-Craft"* PRODUCTS INCLUDE . . .

- Expansion Joints
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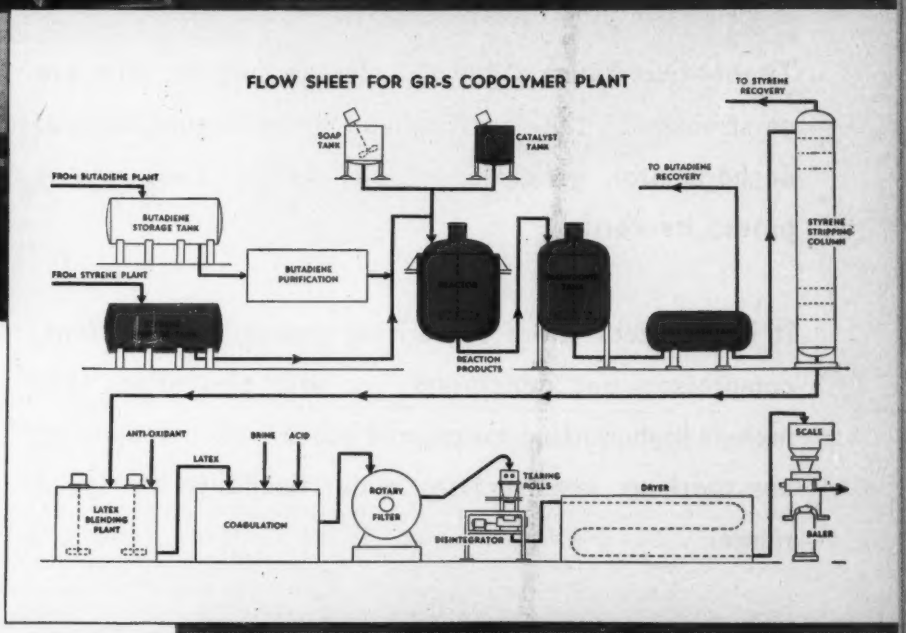
faudler Engineering

solves a difficult problem in synthetic rubber production

Left: Part of a battery of Pfaudler Glass-lined Steel Polymerizers typical of those used in the Synthetic Rubber Plants. *Below:* Glass-lined steel process units are indicated in Red.



w can we prevent butadiene flash during ymerization?" was a question put to Pfaudler ineers at the start of the nation's synthetic ber program.

ynthetic rubber involves a soap emulsion of adiene and styrene. In this critical reaction, re the actual latex is formed, heat is gen- ed which would flash if uncontrolled.

faudler Engineers came through with the tion to this problem as they have so many times in the cess industries. A special glass-lined reactor was designed ch included a new method of water jacketing. Controlled perature is maintained, thorough polymerization is assured.

or nearly sixty years, Pfaudler has helped to solve problems lving corrosion resistance and engineering for the process ustries. The combination of engineering skill, fabricating erience and production facilities enabled Pfaudler to pro- many of the glass-lined units used so extensively in synthetic ber production ahead of schedule.

ong before synthetic rubber entered the picture, Pfaudler s-lined steel equipment was specified by many refineries making petroleum by-products. More recently, glass-lined equipment has become available in the form of isomeriza- towers, catalyst units, heat exchangers, gas absorption ers, etc. We invite your inquiry.

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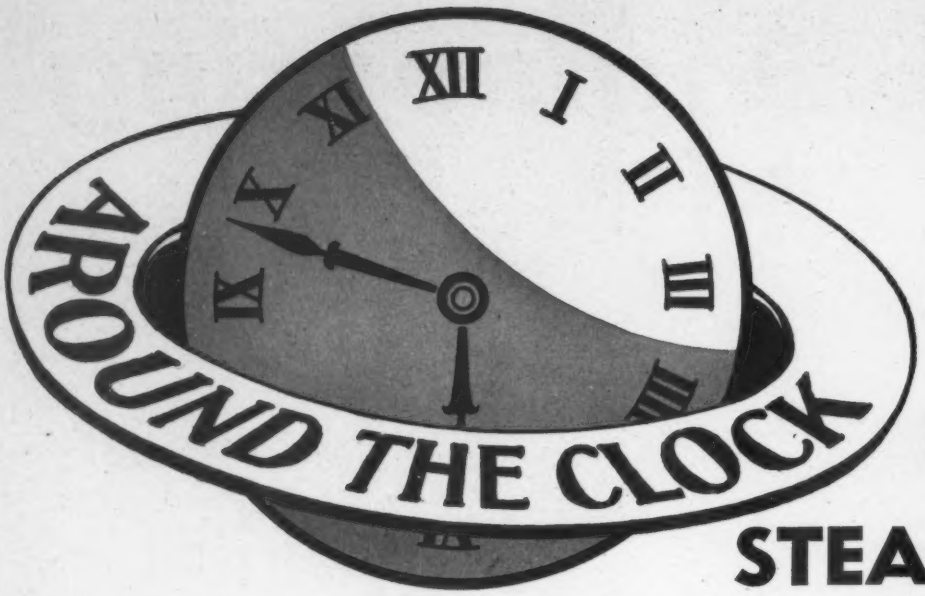
THE PFAUDLER CO., Rochester 4, N. Y. Branch Offices: 330 West 42nd St., New York 18, N. Y.; 1442 Conway Bldg., Chicago 2, Ill.; 1328 Howard St., San Francisco 3, Calif.; 455 Penobscot Bldg., Detroit 26, Mich.; 1318 Lafayette Bldg., Philadelphia 7, Pa.; 721 Little Bldg., Boston 16, Mass.; 1024 Washington Bldg., Washington 5, D. C.

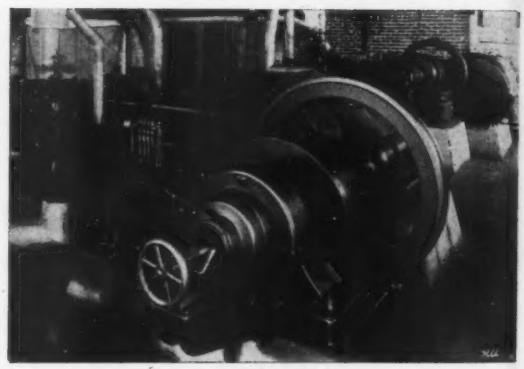


TROY-ENGBERG STEAM ENGINE

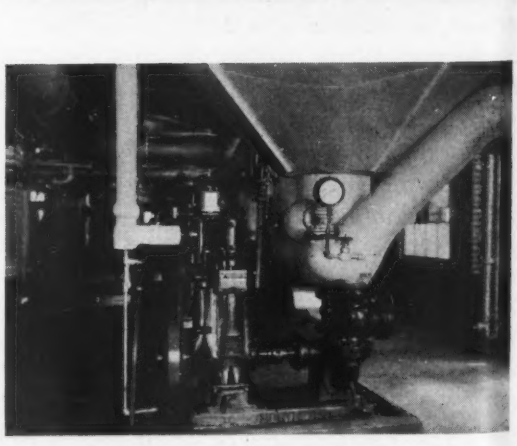
gives

DEPENDABLE POWER

Twenty-four hours a day . . . for as long as units are on stream . . . the Troy-Engberg Steam Engine, vertical or horizontal, gives dependable service. Long ago it proved its worth.



It is the ideal power for driving pumps, blowers, fans, compressors and generators . . . with plus values that include high starting torque and heavy overload capacity; non-sparking construction; wide flexibility in speed range.



The dependability of the Troy-Engberg Steam Engine has never been surpassed by any drive—in low cost of power when plant heat balances are right—or in low cost of maintenance. Its flexibility is reflected in its controllable wide speed range.

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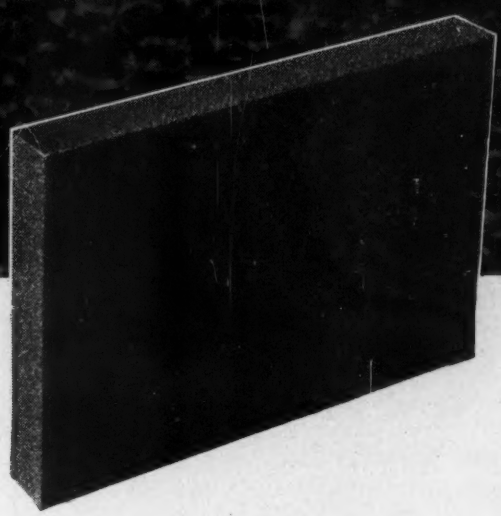

Photograph is enlarged approximately 10 times.

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FOAMGLAS insulation has that rare quality which so many insulating materials lack . . . *permanence.* It's moisture-proof. Vapor-proof. Unaffected by acid atmospheres. Non-combustible. Vermin-proof. Rigid and sturdy of structure. Foamglas consists of thousands of tiny cells of *glass* . . . and partakes of the agelessness of glass. That's why it retains its original insulating value year after year in service. And why it can save you so much in maintenance and replacement costs.

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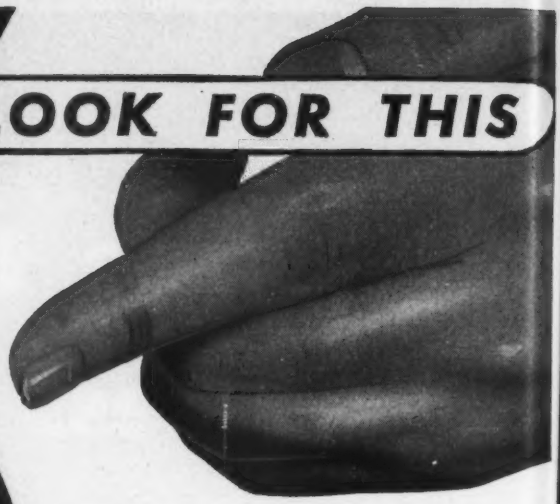

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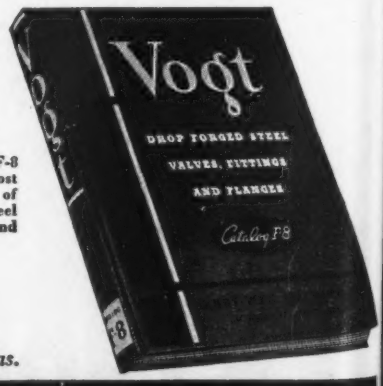

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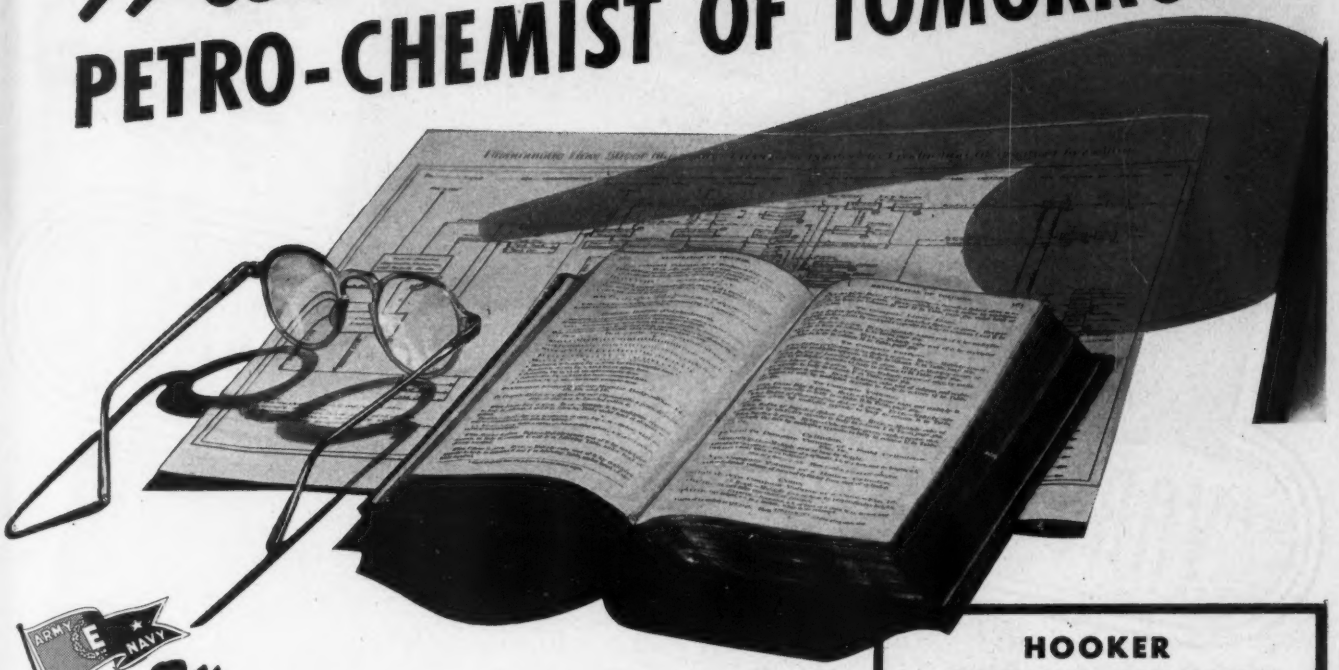
Meet the PETRO-CHEMIST OF TOMORROW



With a bang, a drone, and a rumble, oil is making its wartime echoes heard in Axis strongholds. Toluene for TNT, aviation gasoline and synthetic rubber tires — these three are among the victory contributions of the petro-chemist of today.

In the post-war era, he will give new tasks to these proven petroleum products. He will carry still further such developments as high-stability and high-speed lubricants, liquid coolants for engines, diesel fuel, plastic base stocks and anaesthetics. No list can approach completeness — so rapidly does petroleum chemistry expand its usefulness.

He will make more chemicals from petroleum, using aluminum chloride and caustic soda which have already rendered valuable service in the production of high-octane gas and synthetic rubber. He will use Hooker Chemicals not yet developed, products now in the research laboratory stage.

Let us send you a list of the principal Hooker products now available along with specifications, properties and container data. Ask for Bulletin R10.

And, since it's never too early to tackle tomorrow, why not arrange a consultation with Hooker Chemists? An exchange of views may help us both in shaping post-war plans.

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ALUMINUM CHLORIDE
Anhydrous
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Supplied in 55-gal. drums containing 500 lbs., and 5-gal. pails containing 50 lbs.

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"VAREC" approved Internal Safety Valve insures:

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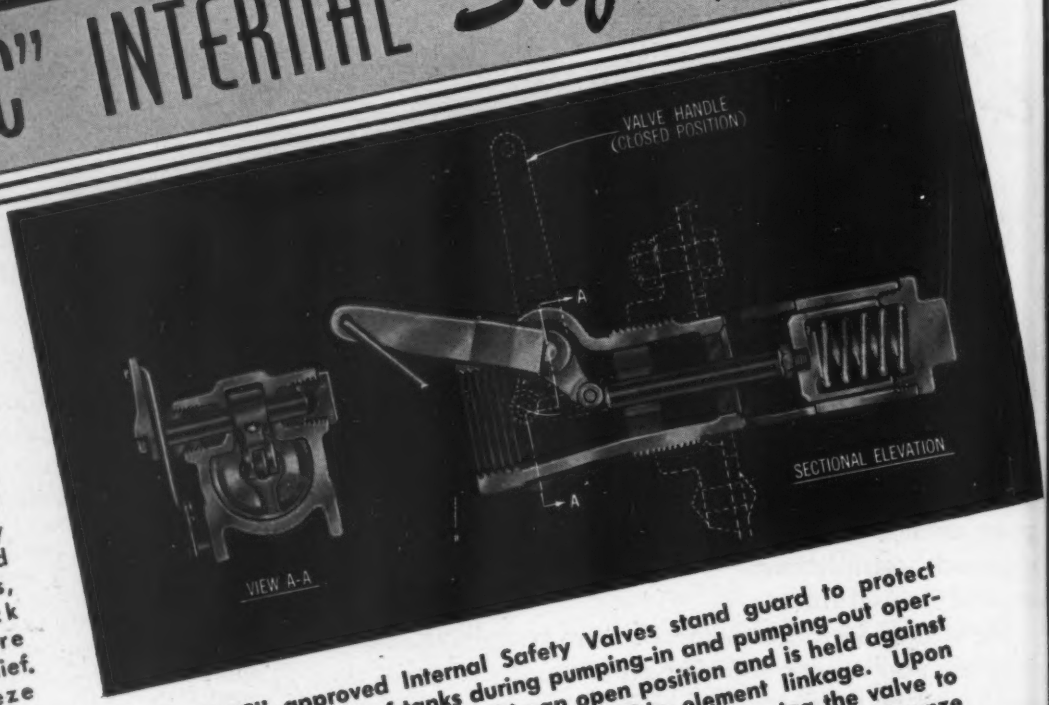
"VAREC" INTERNAL *Safety* VALVE



"VAREC" approved Internal Safety Valves stand guard to protect from fire the contents of tanks during pumping-in and pumping-out operations. The valve disc is installed in an open position and is held against the force of a compression spring by fusible element linkage. Upon exposure to external heat, the fusible element melts causing the valve to snap shut. The 2, 2½, 3 and 4 inch sizes have a threaded cast bronze body with bronze and 18-8 stainless steel trim; 6 and 8 inch sizes have a flanged cast steel body with bronze and 18-8 stainless steel trim; Cadmium plated steel compression spring is standard. This valve is full pipe size capacity. Lever arm can be mounted on either the right or left side of the valve. Tank shell flanges for mounting are available.

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"VAREC" Tank Equipment, Gas Control and Safety Devices Catalog and Handbook P-7 fully describes all "VAREC" Products in detail.

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1 Increased on-stream time—In every installation, Petreco Desalting has increased on-stream time, and in some cases, no *satisfactory* runs were made until Petreco was installed.

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3 More stable kerosene color—A refiner in Michigan reports that Petreco Desalting enables him to command a premium price for his kerosene because of its color stability. Another consistently obtains a clear, 30-plus color on kerosene since the Petreco installation.

4 Decreased ammonia costs—Because Petreco Desalting attacks one *source* of evolved HCl, less neutralization is needed to control corrosion. Numerous Petreco-protected refineries cite ammonia savings as high as 75%.

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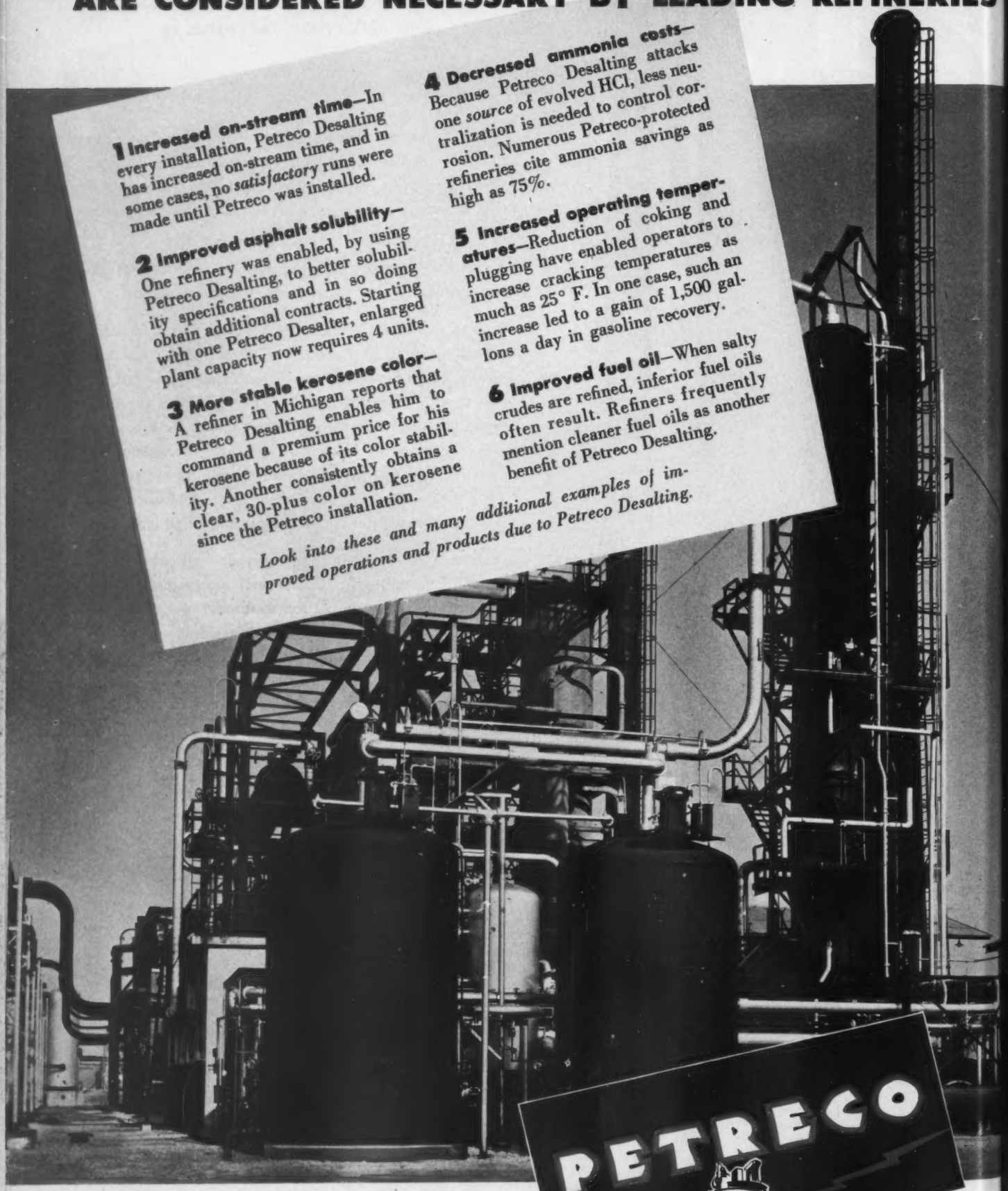
6 Improved fuel oil—When salty crudes are refined, inferior fuel oils often result. Refiners frequently mention cleaner fuel oils as another benefit of Petreco Desalting.

Look into these and many additional examples of improved operations and products due to Petreco Desalting.



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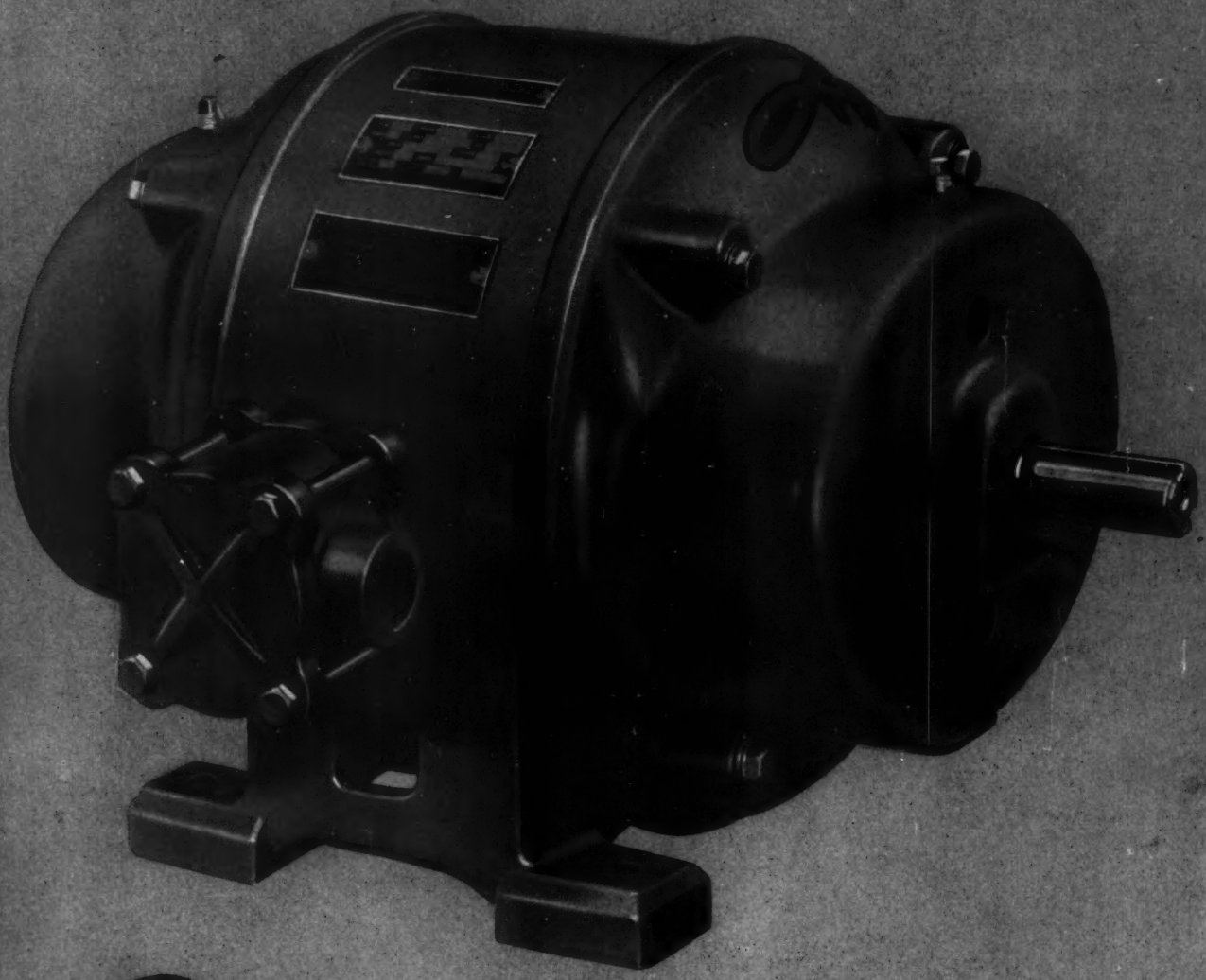
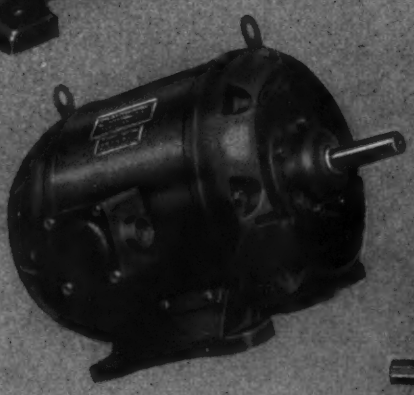


There is a size and type **LOUIS ALLIS** *electric motor for every industrial requirement.*



THE LOUIS ALLIS CO., MILWAUKEE 7, WIS.

Speaking of Electric Motors—

The day of trying to use a standard motor for a special job is about over.

Machinery designers, and production managers have learned that it is much more efficient and economical to obtain a motor with exactly the electrical and mechanical characteristics required to perform a specific job than it is to try to doctor up a standard "shelf" motor to do the job.

Speed and horsepower are no longer the major measuring stick of motor requirements — they are merely incidental to the many other characteristics available in electric motors today.

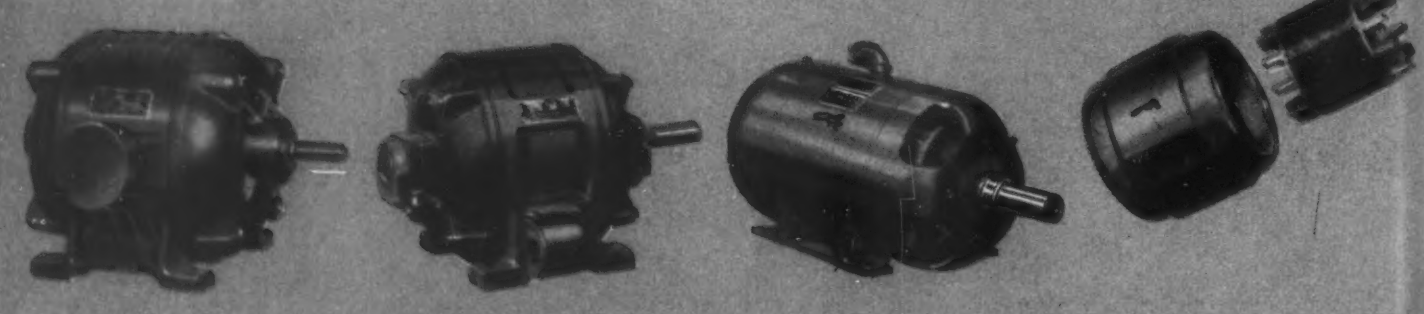
For over forty years we have been developing special motors for special jobs — our engineering department has a wealth of experience along this line —

Right now special Louis Allis motors are serving a major important role in helping your boy and mine win this war — to help bring him back home — safely — and as quickly as possible.

As soon as Uncle Sam does not so urgently need all of our facilities — your electric motor problems and requirements will receive our most prompt and careful attention in every way.

But right now — let's WIN this war!

THE LOUIS ALLIS CO., MILWAUKEE 7, WIS.



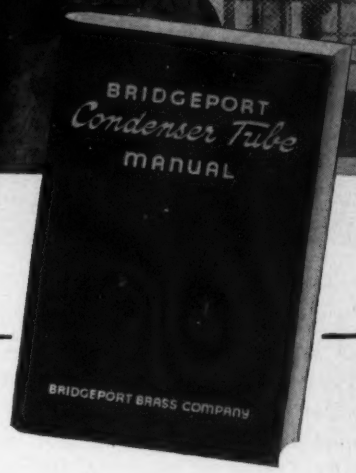
Brass for Oil–the Two-Edged Sword...

Yes, oil, being the source of both gasoline and synthetic rubber, is a mighty two-edged sword that carries double cutting power in attacks on the enemy today. And in the refining and production of these two vital materials, tons and tons of copper alloy heat exchanger and condenser tubing play a vital part.

To stand up longer against corrosion, Bridgeport has developed special alloys such as Arsenical Admiralty which resists destruction from both oil and polluted waters; Bridgeport Arsenical Muntz designed for corrosive sulphur bearing oil as well as for bad water; also Bridgeport Duplex Tubing which combines a wall of brass, copper or cupro nickel with another of steel or aluminum, etc. Other alloys are also available for special conditions.

The characteristics of Bridgeport tubing alloys are described in our new Condenser Tube Manual. Engineers will receive valuable help from the section on corrosion research, the latest specification data, the methods of installing tubes, and from its numerous tables and general information. Write for your copy today.

"Bridgeport" BRASS CO. **BRIDGEPORT BRASS COMPANY**
BRIDGEPORT 2, CONN. • ESTABLISHED 1865



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Name_____

Position_____

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City_____ State_____

Do You Use Condenser Tubing?_____

Shall We Send Technical Adviser?_____

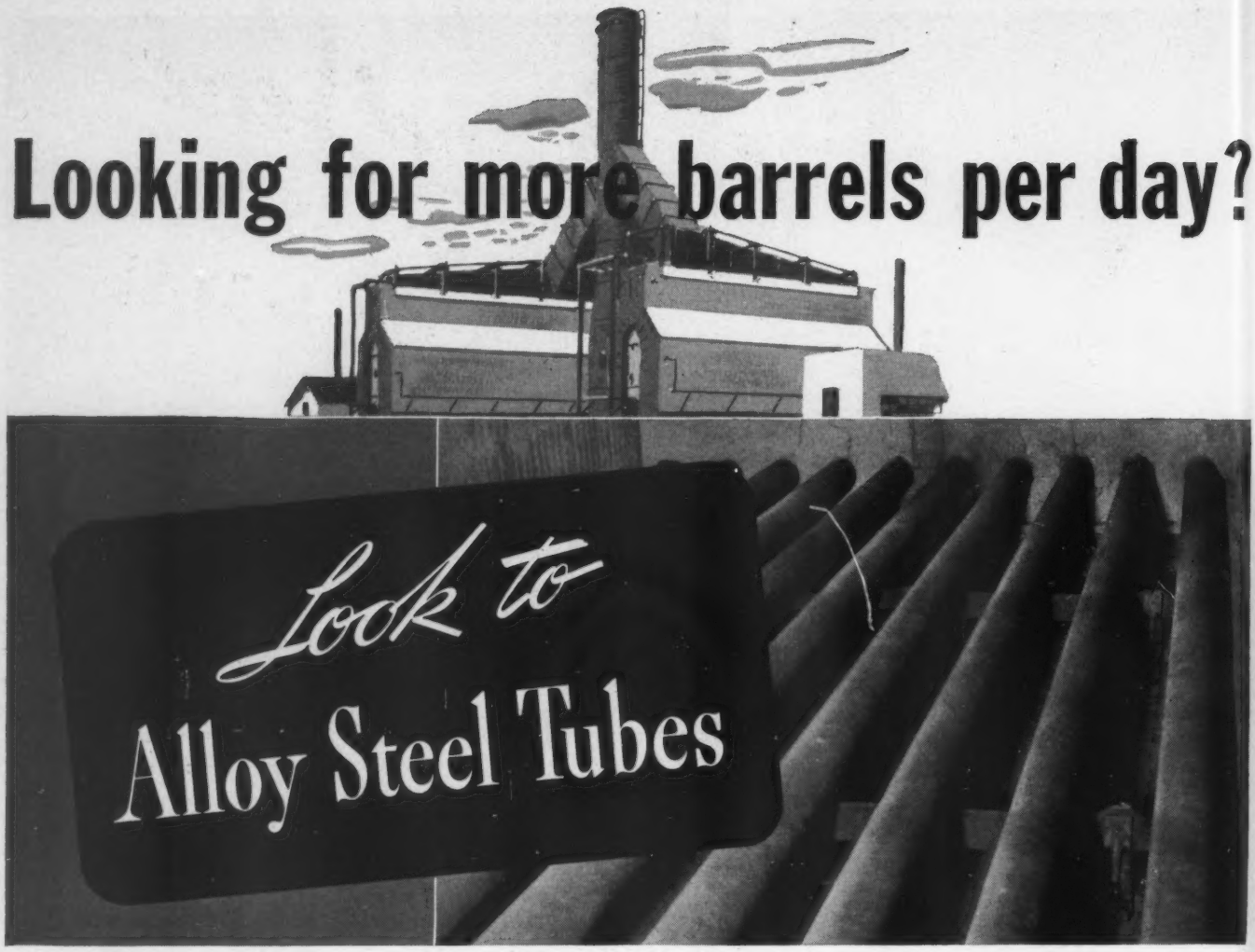
Any Corrosion Problems?_____

_____

BRIDGEPORT

BRASS

Looking for more barrels per day?



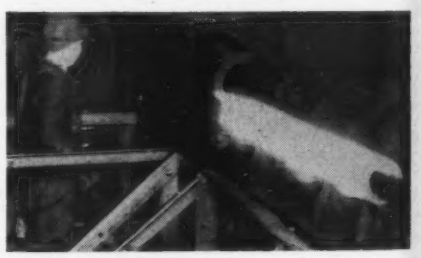
START at the beginning, right with the cracking still tubes. Working at extreme temperatures, under extreme pressure, these tubes must be metallurgically and physically "tailored" to your individual requirements. That is the sort of service you get from Tubular Alloy Steel Corporation.

Producing the greatest number of barrels per day means keeping the most efficient equipment in the nearest thing to perpetual operation. To do that you must have just the right combination of metals to withstand the sort of corrosion, erosion, scaling and fouling conditions that attack not only your still tubes, but also tubing for heat exchangers, condensers and other special purpose apparatus.

In refineries that use the right alloy for each tubing application, equipment remains on stream for longer runs, down time for cleaning is reduced, maintenance, repairs and replacements are minimized, in short —operating costs are down to bedrock, while production records soar to new highs.

Our Service Engineers are prepared to cooperate with you in analyzing your requirements, in selecting the tube size and steel grade that will enable you to produce more barrels per day — most economically.

Make full use of this free service, when you again need alloy tubing.



Heart of the seamless process. Piercing a billet of highest quality alloy steel to form the basic tube. The result is uniform wall thickness with no welds which might form weak spots.

Steel needs more scrap NOW . . .
Send it in!

The newest name in alloy tubing

TUBULAR ALLOY STEEL CORPORATION

Gary, Indiana

Columbia Steel Company, San Francisco, *Pacific Coast Distributors* · United States Steel Export Company, New York

UNITED STATES STEEL

FISHER *Gland Seal*

DIAPHRAGM MOTOR VALVE FOR HYDROFLUORIC ALKYLATION SERVICE

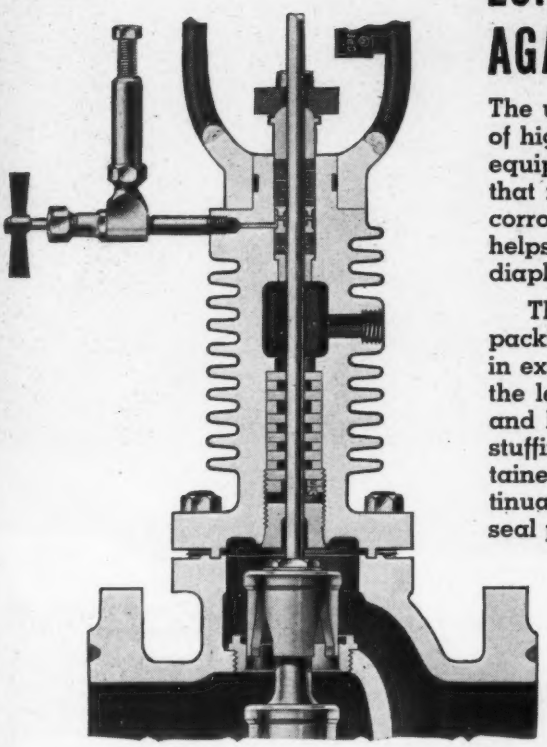
ESPECIALLY DESIGNED TO SAFEGUARD AGAINST STUFFING BOX LEAKAGE

The use of hydrofluoric acid as a catalyst in the production of high octane gasoline requires specialized refinery control equipment because of the extreme precautionary measures that must be observed in handling HF due to its toxic and corrosive properties. The new Fisher gland seal assembly helps to meet these rigid service requirements imposed on diaphragm motor valves.

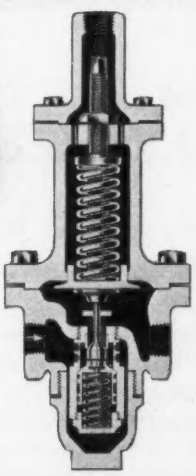
The sealing gland is a labyrinth of close fitting steel packing rings. A neutral fluid is introduced—at a pressure in excess of the main line downstream pressure—just above the labyrinth to effectively prevent any leakage of the acid and hydrocarbon fluid around the valve stem and through stuffing box to the atmosphere. Excess pressure is maintained by a special Fisher Differential Regulator that continually keeps a constant differential between the gland seal pressure and the pressure in the main valve body.

Low silicon, steel or other metals resistant to HF are used in all parts exposed to the fluid under control.

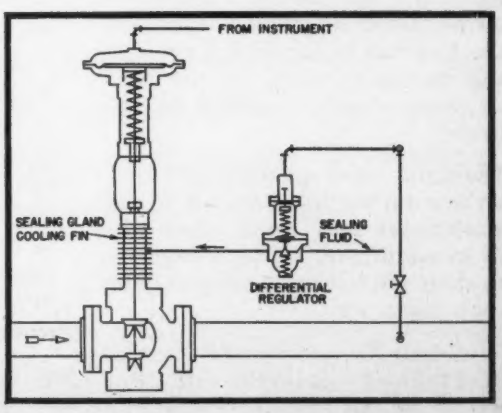
Write for full information—recommendations for your particular requirements gladly submitted.



Sectional View . . special cooling fin member of sealing gland diaphragm motor valve showing labyrinth sealing gland rings, differential pressure inlet, lubricator with isolating valve, and deep bolted gland stuffing box.



Above: Differential Regulator—especially designed for this specific HF service.



Right: Typical HF Catalyst Pressure Control installation.

FISHER GOVERNOR COMPANY
145 FISHER BUILDING
MARSHALLTOWN, IOWA

WeldELLS have everything ★

"They're built to give the man on the job a hand"

FROM the way they pile the work on me these days you'd think my job as foreman of the pipe crew is to put in the piping today that the front office won't finish planning till tomorrow!

The front office crowd might consider that laying it on a little thick. But whatever they think, they will have to admit that we have kept up with their wildest demands and done the job right, too.

Of course the main credit for that goes to fellows who do the work. But down to the last man they would be the first to agree that they couldn't have covered as much ground, or covered it as well, if it hadn't been for their old friend, WeldELLS.

WeldELLS and other Taylor Forge Welding Fittings are built to step in and give a hand. You don't have to grope for the proper size because size and weight are marked right there on the fitting. Tangents make them easy to line up. Accurate lathe bevels and lands make welding fast and sound. Precision quarter-marks guide the work.

If you want a fast job — a sound job — an economical job — take a tip from me and use the welding fittings that have *everything!*

★ **WeldELLS alone have all these features:**

- **Seamless** — greater strength and uniformity.
- **Tangents**—keep weld away from zone of highest stress—simplify lining up.
- **Precision quarter-marked ends**—simplify layout and help insure accuracy.
- **Selective reinforcement** — provides uniform strength.
- **Permanent and complete identification marking**—saves time and eliminates errors in shop and field.
- **Wall thickness never less than specification minimum**—assures full strength and long life.
- **Machine tool beveled ends**—provides best welding surface and accurate bevel and land.
- **The most complete line of Welding Fittings and Forged Steel Flanges in the World** — insures complete service and undivided responsibility.

The list of Taylor Forge's contributions to the war effort only begins with WeldELLS. One of many examples is Taylor Corrugated Marine Furnaces, essential to many merchant ships and transports.

* WeldELLS and many other Taylor Forge products are produced in Byers Genuine Wrought Iron.

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Bingham

FIELD-PROVEN PIPE LINE PUMPS

THE LARGEST pipe line companies in the oil industry use Bingham pumps —a most emphatic proof that Bingham pumps are top performers.

It isn't necessary to come to the Bingham factory to check on Bingham engineering and design, or the quality of materials, or the precision standards to which Bingham pumps are built.

Simply wire us, or your nearest Bingham sales office, for name and location in your territory where Bingham pumps are installed. Judge for yourself, under actual field conditions, how Bingham pumps perform, what owners think, how Bingham can solve a pump problem for you. Your inquiry is welcome at our sales office, or direct.

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EDWARD 6000 LB HYDRAULIC VALVES

FOR PUNISHING PRESSURES

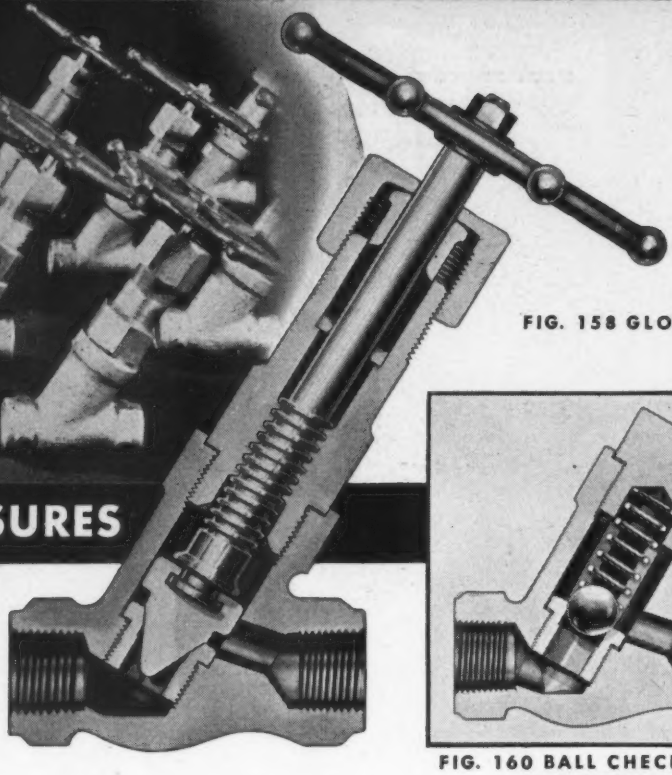


FIG. 158 GLOBE

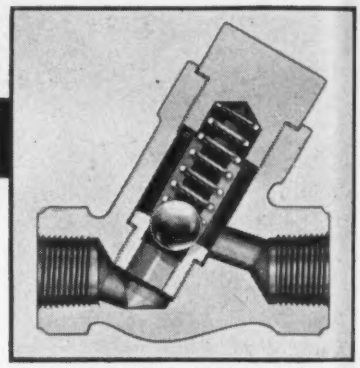
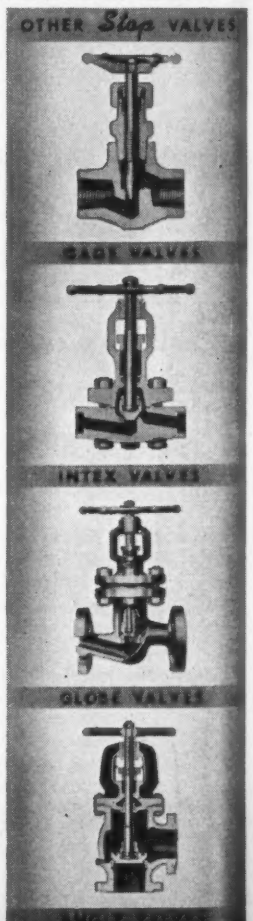


FIG. 160 BALL CHECK VALVE

THOUSANDS of excessive pressure systems operating under 300 F depend on Edward Fig. 158 globe hydraulic valves for fast, certain shut-off or accurate pressure control.

The seat and swivel needle disk are made of EValloy, Edward's own development in abrasion resisting stainless steel. The inside screw construction, the extra deep stuffing box and the special gland and packing nut design lengthen packing life and prevent leakage along the stem. Streamlined body contours permit free flow at high velocities with low pressure drop.

These—and other—specific advantages of Edward Fig. 158 valves add up to savings in maintenance time and replacement parts. For information on valves in the Edward line write for Edward BETTER VALVES Catalog No. 101.



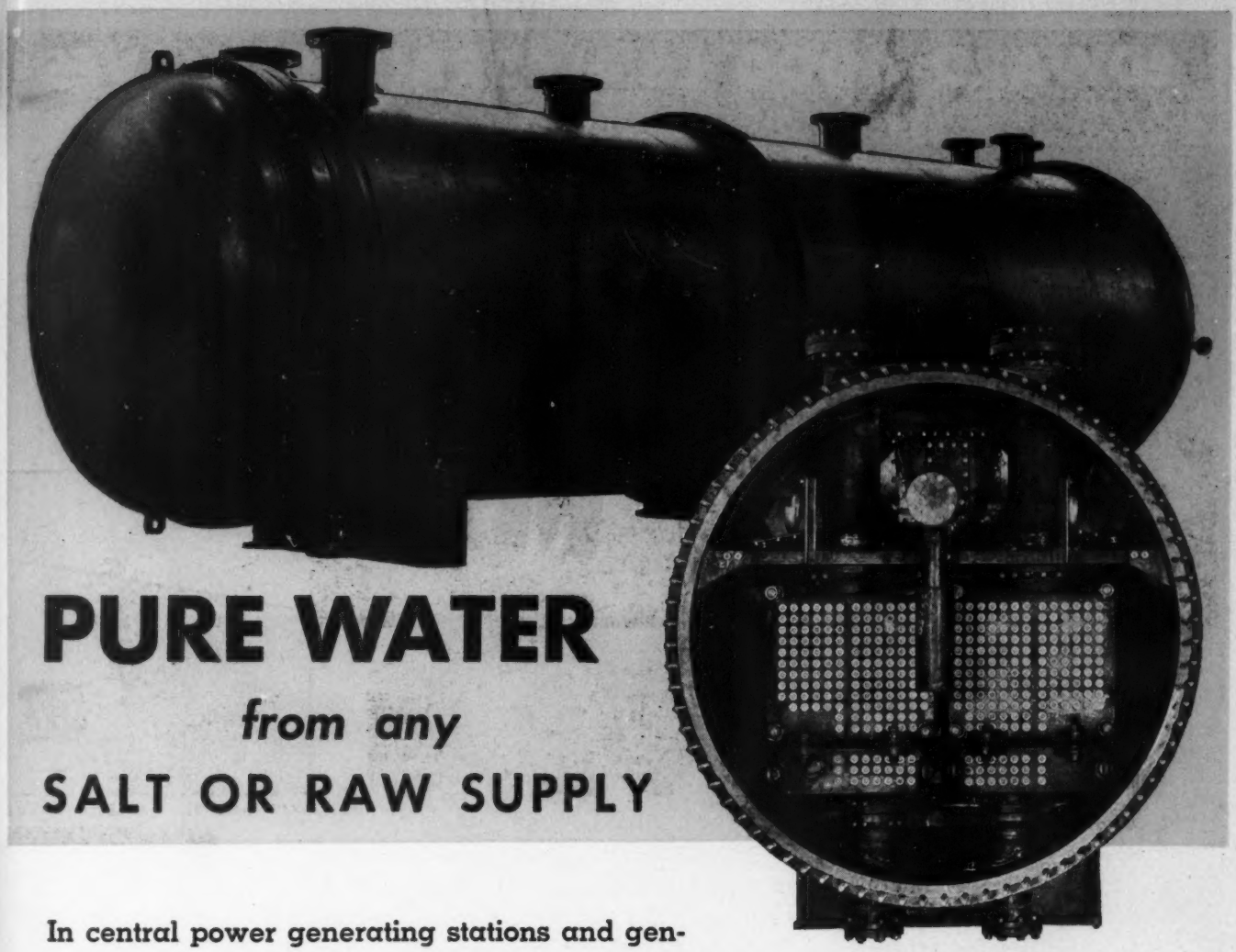
Corresponding ball check valves, Fig. 160, with same ratings, also available.

DIMENSIONAL DETAILS OF EDWARD Fig. 158 and 160 HYDRAULIC VALVES
For power, petroleum, chemical process, marine, technological or general industrial service
Rating 6000 lb at 125 F
Globe type, screwed or socket welding ends

SIZE	¼"	⅜"	½"	¾"	1"	1¼"	1½"	2"
End to End, Fig. 158 and 160	3¾	3¾	3¾	4½	5⅛	6½	7½	9
Center to Top Open, Fig. 158	8¼	8¼	8¼	9¼	10⅞	13¾	14⅞	18
Handwheel Diameter, Fig. 158	5⅜	5⅜	5⅜	6⅜	8½	10⅛	10⅛	11½
Weight—lbs, Fig. 158	3¼	3¼	4¾	7	12	22	37	62
Weight—lbs, Fig. 160	1½	1½	2¾	4½	7¼	13½	19¾	40

THE EDWARD VALVE & MFG. CO., INC., 2 W. 145th Street
East Chicago, Indiana

EDWARD *Steel* VALVES



PURE WATER

from any

SALT OR RAW SUPPLY

In central power generating stations and general industrial plants . . . on naval and commercial vessels . . . in refineries and chemical process plants . . . wherever pure water is required for boiler feed make-up, process work, or general services . . . G-R Evaporators have established records for dependable, economical operation. These units do not require hand-scaling, and can be maintained by unskilled labor. Varying raw water conditions do not affect the product under wide limits. The distillate produced meets the exacting purity requirements of present day practice.

THE GRISCOM-RUSSELL CO., 285 Madison Ave., New York 17, N. Y.

Look into this G-R BENTUBE EVAPORATOR

Note the rugged construction, unusually large clearances, and widely spaced tubes. The heating surface of this unit consists of patented scale-shedding Bentube elements. Temperature variations change the curvature of the tubes, thereby shedding the scale. G-R Bentube Evaporators can be furnished for large or small capacities, and in single or multiple effects for any requirements.

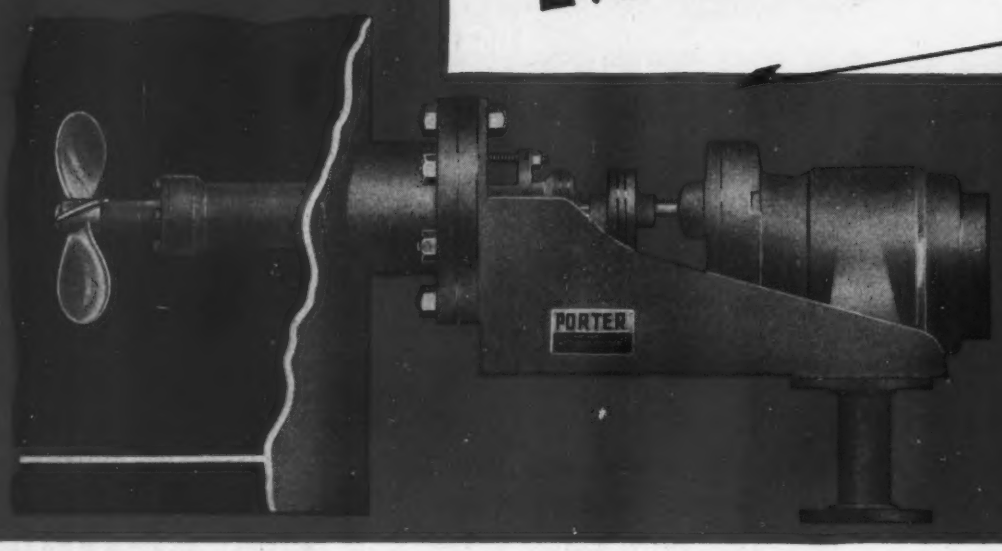
GRISCOM-RUSSELL

Pioneers in Heat Transfer Apparatus

YOU CAN ACTUALLY

Step up output with—

PORTER MIXERS



Because PORTER MIXERS are Better Built, they are capable of longer-sustained operation, fewer shut-downs for repairs or maintenance. Efficiently designed for a wide range of blending operations, Porter Mixers meet every demand for continuous, stepped-up production schedules.

The Porter Side-Entering Mixer illustrated here is ideally designed for ethyl-blending tanks, providing a powerful whirlpool current when mounted diagonally. In addition to the Side-Entering Mixer, the Porter line includes a Porter Mixer for every mixing operation about a refinery.

Write today for complete Porter Catalog.

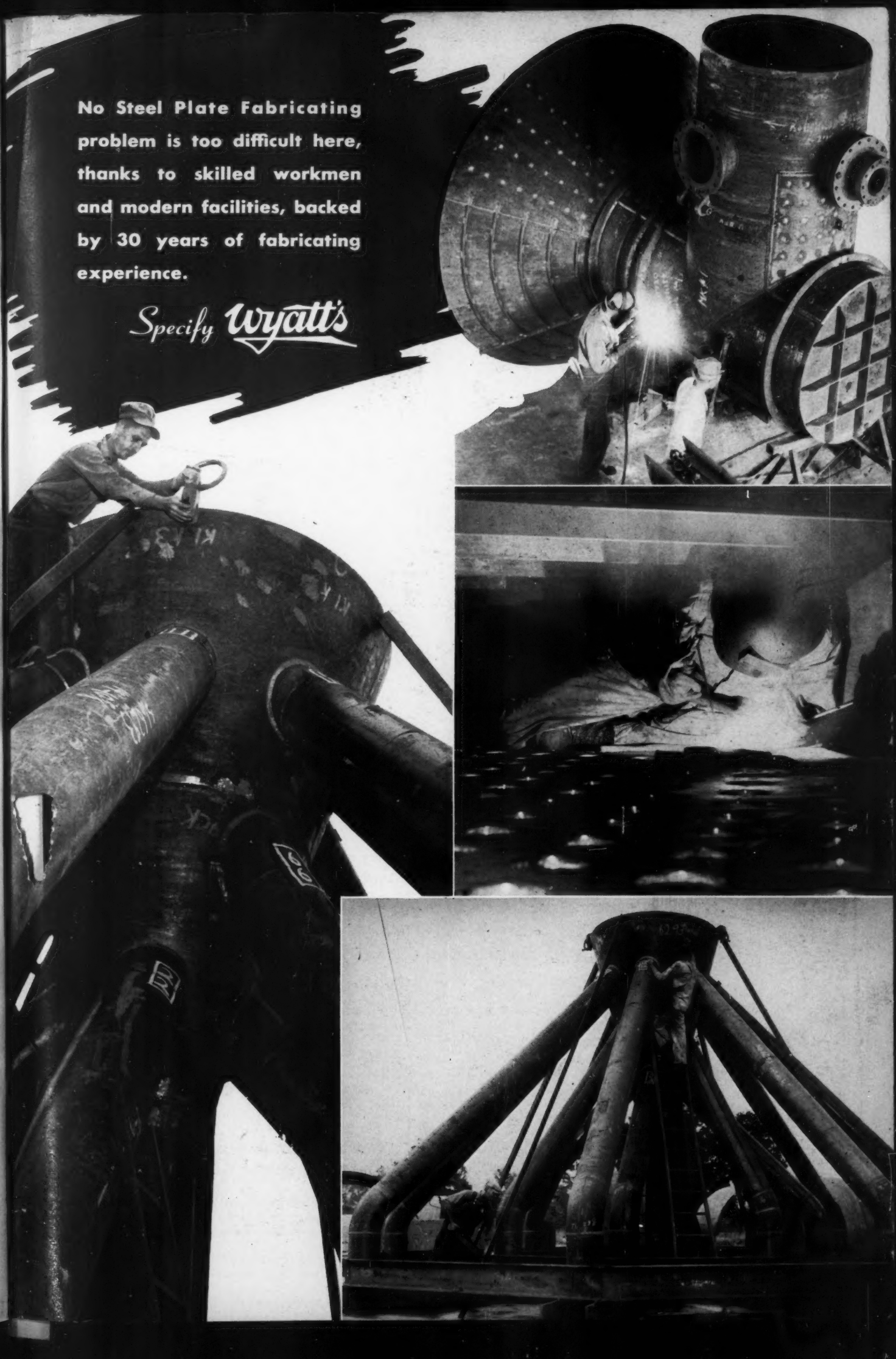
PORTER "Better Built" Equipment
Established 1866

ARMY E NAVY

PORTER BUILT means BETTER BUILT

H. K. PORTER COMPANY, Inc.

PROCESS EQUIPMENT DIVISION • PITTSBURGH, PENNSYLVANIA


No Steel Plate Fabricating problem is too difficult here, thanks to skilled workmen and modern facilities, backed by 30 years of fabricating experience.
Specify Wyatt's

Leadership

. . . more pronounced today than ever before

Plate 890-T

Year after year McDonald Hand Rotary Pumps for gasoline, oil, etc., lead the field because McDonald engineers make it their business to *set the pace* in improved design and manufacture.

Take the Plate 890 STA-PRIME for example. Its introduction marked not merely a new model but a basic advance in hand rotary pump engineering. Never before has there been a pump with such an impressive group of exclusive features. It requires *no* foot valve, and yet holds its prime under all conditions. Suction, 1". Discharge, ¾". Approximately 10 revolutions delivers one gallon.

Plate 883-T

The 883 series answers the need for a low-priced, highly efficient pump with a capacity not to exceed 7 GPM. Suction, ¾". Discharge, ¾".

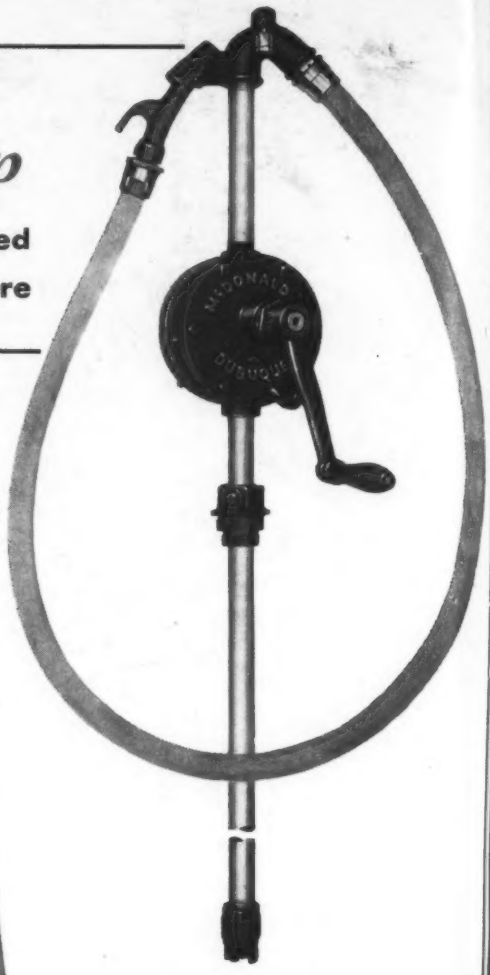


Plate 906-T

The 906 series—for gasoline, oil, paints, alcohol, etc., is distinguished by low cost, easy operation and large, steady flow. Suction, 1". Discharge, 1".

All of the pumps shown can be furnished as illustrated, or in other combinations. They are available with a gooseneck at the outlet end—or, if desired, we can supply the pump only, without any connections. Write for special pamphlet showing all McDonald Hand Pumps.

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